FINAL REPORT

City of Wichita
Fire Station Location Study

Wichita, Kansas

February 2000

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Submitted to:

City of Wichita
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February 2000

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ACKNOWLEDGMENTS

We wish to thank the many members of the Wichita Fire Department who not only provided information to us during the study, but also actively participated in reviewing and developing various options.

We are grateful to the Finance staff for their leadership of the project and coordination of numerous complex data requests and analyses from the City's Geographic Information Systems Division and Fire Department, as well as participating in the analysis.

The study would not have been possible without the outstanding effort of the Data Center, especially the Geographic Information Systems Division. They were in the process of developing the relatively new GIS capability in real time during this study. They managed to go further with the analyses than was envisioned at the outset of the study, which allowed a more refined analysis to be undertaken.

Despite all the cooperation noted above, the evaluation and recommendations are those of the TriData project staff. Principal members of the study team and their prime responsibility were as follows:

Philip Schaenman – Project Manager
Dr. Charles Jennings – Demand Projection and Station Location Analysis
William Richmond – Operations Evaluation
Ruth Barth – Project Coordination
Maria Argabright – Project Support
David Cohen – Intercity Analysis

EXECUTIVE SUMMARY

The City of Wichita, Kansas is an urban metropolitan area that has witnessed steady growth over the past decade from 298,000 in 1989 to about 337,000 in 1999. The City plans further annexation along several boundaries that will foster growth into the future.

While the service rendered by the Wichita Fire Department have been adequate throughout most of the City, there are problems of coverage along the periphery, and they are likely to get worse without some redeployment and additions of some resources.

To help plan for maintaining city-wide service levels in newly acquired areas, and to evaluate the efficiency and effectiveness of resource deployment, the City of Wichita competitively contracted with TriData Corporation of Arlington, Virginia to undertake an objective, third-party study of the fire department. The study was to project demand for fire services, evaluate current level of services, and develop cost effective alternatives for the future.

Below are the highlights of the findings and recommendations. The reader is encouraged to look also at the color maps throughout the report, which graphically show the current coverage problems, and the benefits of the recommendations.

Current Operations

Overall, the citizens of Wichita are being well served by their fire department. The average response time of just over five minutes puts Wichita among the leading edge of cities its size. However, there are areas on every border of the City that have less than half their calls meeting the response time goal, and some small problem pockets within the City.

The Fire Department, along with those in many other large cities, has been evolving from its original purpose of fighting fires to its current much wider mission of providing a range of sophisticated fire and safety services. The largest category of fire department activity today is for emergency medical responses, working closely with Sedgwick County's paramedic ambulances.

The City has created a class of units not commonly found in large cities, the squad truck, a two-person vehicle that carries a small pump and hose in the truck bed. It is used both for EMS calls and for fighting small fires. The two people assigned to these units often operate with a three-person engine or quint company as a task force. This has been a very effective practice, made possible by not having to perform many emergency medical transports, which are handled by the County ambulance service.

The City also has made extensive use of quints, vehicles that can be used either as an engine company or ladder company, another efficient, modern approach.

However, a significant problem with the current fire system is that aerial companies are often understaffed. The two-person crew that cross-staffs the aerial and is supposed to bring the units to fires is often out on EMS or other calls, and may not be available to take the ladder (though this frequency of occurrence was not known). Their staffing of two is generally too low to be effective according to national practices.

The result of the above practices is a much more complex dispatching environment, difficulty in managing operations at fires due to the diversity of units, and the lack of knowledge of how many units and personnel will show up, and when. Not being able to count on a prompt, fully staffed aerial company is a particular liability in quickly starting the many truck and ladder company functions such as rescue, laddering, and ventilation. Compounding the problem is the lack of adequate unit status monitoring by Dispatch, because of the diversity of vehicles and the overloading of dispatchers and communications channels, which, in turn, leads to some confusion in operations.

Demand Projections

A range of demand projections were made out to 2010. Both optimistic and pessimistic projections were made. The optimistic model projected per capita rates at the current levels, so that demand grows in proportion to population. The pessimistic model assumes continued increase in per capita demand as well as in population, resulting in considerably higher demand. The range was from about 50,000 calls to 63,000 calls in 2010. We also considered a sensitivity analysis of an additional 10 percent in demand for 2010, to account for the sharper increase in call volume in the two most recent years (1998 and 1999).

The results of the demand analysis were quite good news for the citizens of Wichita: the current system of fire units can absorb much more demand than it currently is handling in terms of workload. There are very few units that are even moderately heavily loaded at present, and only a few units that are projected to exceed the 3,000 response level by 2010. While response times will slightly degrade as call volume increases, because of the increased frequency that the first-due (nearest) unit is not available when called, the current system could handle much more work than it is now. However, because much of the growth in population and calls is occurring at the periphery, there is a spatial problem – longer drive times from the existing stations than would be satisfactory for providing adequate response times. The upshot is the need to add several stations to handle the increasing geographic spread of the population. Also, because of the shifts in population and in the call mix, a number of station relocations are recommended to improve the overall efficiency of the system.

Recommendations

There is no single optimum arrangement of stations, because of the uncertainties in demand, the complexity of the overall response network and the lack of adequate mathematical tools to deal with the problem. A set of station locations must be analyzed as a whole, because moving some stations opens up other holes, and adding stations can create overlaps with existing stations. The overall idea is to maximize the use of units to (a) get the best first-due response times, and also (b) have a robust enough system to provide good second- and third-in unit responses for fires and major emergencies and to fill gaps when other units are committed on emergency calls.

Station Locations – TriData and the City staff reached a consensus on the following set of recommended new stations and changes. We recommend adding two stations and moving eight other stations over the next decade. There would be a net increase of 13 on-duty positions (44 firefighters in total over 10 years). This is a relatively modest package to keep up with demand over the next decade. We believe the redeployment recommended will make better use of the existing resources. The order in which the new stations should be added should be a function of the time frame in which the various areas of the City develop; as areas are developed, those with the highest response times and non-trivial call volume (or larger number of population served) should be addressed first.

The proposed station changes and their likely priorities in time are shown in the table below. The rationale for each are discussed in detail in the text, and illustrated with response time maps.

Station Change	Project Start	Open Station
Relocate Station 13 to K-42 and Harry	2000	2001
Relocate Station 12 to 31St S. and Meridian	2000	2001
Relocate Station 19 to Broadway and MacArthur	2000	2001
Relocate Station 7 to 21st N and Amidon	2001	2002
Add Station 6 at 4300-4600 N. Meridian. Close Station 4 where it now is	2001	2002
Relocate Station 15 to Webb Road and Harry	2002	2003
Relocate Station 4 to 127th E and Kellogg	2002	2003
Relocate Station 10 to 21st N. and Hillside	2003	2004
Add Station 20 at 135th W. and 13th N.	2006	2007
Relocate Station 11 to Hillside and Pawnee	2008	2009
Total:	**10 stations to be built: 8 relocated, 2 new stations added**	

Many of the proposed station moves take advantage of the need to rebuild some old stations; if they have to be rebuilt, why not choose a more optimum position?

Going into the future, the City should continually monitor its system response characteristics using better data than is available today. Not only should first-in response units be measured, but also the average time for the second-in unit, and the time to get a complete response to the scene. Individual unit workload statistics should be monitored to see if any excess workloads are developing. If there is an overload, the first strategy considered should be to share workloads among existing co-located units, e.g., have an engine pick up some of the EMS calls of an overloaded squad. If a particular area of the City develops unexpectedly heavier demand than can be handled by the units in the stations, then adding a squad to a nearby station without a squad should be considered to relieve the load – or a new station opened.

Unit Deployment – We recommend a slightly revised deployment of the existing resources for improving some of the existing response shortcomings. We recommend increasing staffing from 3 to 4 for several engine companies and quints that are in areas where they have to operate on their own for longer than desired periods before the next closest unit arrives. This would allow at least two firefighters to be sent into a fire building and still abide by current safety practices of keeping a team of two outside until the next closest unit arrives. The four-person units also improve the ability to assemble an adequate sized first alarm firefighting force.

We also recommend providing dedicated staffing to the ladder companies. Although they get fewer calls than the other types of units, it is essential for them to be adequately staffed when they do arrive, because they have critical rescue and ventilation tasks to perform quickly, and they must be used in pairs for safety. Their staff can help share the other fire calls, too: workload balancing can be achieved by rotating individuals or crews between engines and ladders in the same station, and/or by assigning calls to ladder companies either with their full unit or in two-person units. (That is, the ladder crews do not always have to be the same nor always take the ladder for all calls, and the ladder trucks can withstand far more calls than they are being used for.)

We recommend doing away with the three two-person rescue units. Few, if any, cities use two kinds of two-person units as Wichita does. This function can be taken over by ladder trucks and other units. We think their staffing would be better used for dedicated ladder staffing and four-person units, without hurting response times much.

We also recommend eliminating Engines 21 and 22, which each are the second engine in a two-engine station house, in favor of using their crews elsewhere. They are where they are to increase staffing and units available in the center city. There are, indeed, some areas with concentrated numbers of structure fires, but again, for overall life safety, we think it is important to maintain good responses all over. Today’s office buildings incorporate more safety features than those of yesteryear. Also, with the recommended dedicated ladder staffing, more firefighters can be concentrated at a structure fire than is the case today with the same number of units.

The recommended station location changes would maintain response times with the expanded demand, allow for stronger responses and clearer, simpler dispatching, and a more uniform array of units. Specific recommendations for the staffing and location of each unit are provided in Table 4.5, Chapter IV.

Ladder Company Deployment – A special subject in unit deployment is the placement of ladder companies. They are infrequently used, but when you need a ladder there is no substitute. Some of the ladder coverage today is not as good as it appears on paper because the units are cross-staffed by two-person units, which often are out on calls and not available. Some areas of the City do not have satisfactory ladder coverage. By using dedicated units and the quints, ladder coverage would be significantly improved.

Battalion Chiefs – The three Battalion Chiefs on duty each shift now are all concentrated in the center of the City. That is a benefit when there is a large central fire, but the price to pay is longer Battalion Chief response times to many other incidents. The Battalion Chiefs currently are at Stations 1, 2, and 9. We recommend that one be moved from Station 1 or 2 to Station 17 or to a new western station. (Station 17 might need some remodeling to accommodate the Chief, or another nearby station used.)

GIS Capability – A significant by-product of this study was to enhance the analytical capability of the City's Data Center for undertaking fire department deployment analyses. The City's Geographic Information System (GIS) and input from the Fire Department helped produce the various maps contained in this report, and many others used in the analysis. The Fire Department and GIS Department should use this new capability to periodically update and refine the analyses in this report to explore the pros and cons of various station locations as the City's annexation and street network development continues.

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All in all, the citizens of Wichita have been fortunate in the level of service they receive from their fire department. They can anticipate a continued high level of service if a relatively modest increase in resources is made to keep up with demand.

I. INTRODUCTION

The City of Wichita is steadily growing in population size, and also in geographic area through annexation. It is now about 337,000 population and projected to reach 365,000 within the next 10 years. The number of fire service calls also has grown and the mix of calls has changed significantly over the past decades, as it has in most communities. Emergency Medical Service (EMS) calls now comprise 70 percent of all emergency calls to the Fire Department. False alarms, mostly from automatic alarm systems, outnumber actual fires.

As a result of these continuing changes, the City has been re-considering its vision and plans for its Fire Department in both the immediate future and long range planning.

Similar to most cities, the cost of fire service in Wichita is driven by the number of firefighters in suppression. That number, in turn, is driven by the number of stations, the number and type of units per station, and the staffing of each unit. The deployment of resources has many options. It is not a precise science, even with the many tools that now exist to improve quantification of the choices.

In mid-1999 the City competitively selected TriData Corporation of Arlington, Virginia, to provide an objective, third-party evaluation of the current level of services and to recommend cost-effective deployment options for the future. TriData has conducted similar studies for many like-size communities throughout the nation.

Scope

This study evaluates the level of service provided by the current set of stations and deployment of resources, and whether the number and location of stations, the mix of units and their staffing is most cost-effective. The study considered alternatives for the future in light of the anticipated continued growth in population and area.

More specifically, the study was asked to address the following questions raised in the RFP:

- For current service demands, how many fire stations should the City have and where should the stations be located, or relocated, for the most cost effective and efficient service?

- For anticipated service demands, how many fire stations should the City have and where should the stations be located for the most cost effective and efficient service?

- If the recommendation is for more than the current number of stations (18), what are the specific benefits of each additional location (response time, increase in percent of fire containment, decrease of station alarm volume, and other cost-service benefits[1])?

- Are the current resources, physical and human, most effectively and efficiently deployed? If not, recommend improvements.

- Is the equipment adequate (quantity, size, location) for current service demands? Is the equipment adequate anticipated growth of the City? If not, what are the shortcomings and recommendations with a cost benefit analysis?

- What other fire response options and strategies might be suitable to the culture and environment of the City?

The study focused on Fire Department operations – the delivery of firefighting and EMS. Not included were support services and prevention, the other two major components of fire departments. Also not included was the quality of EMS medical care (as opposed to its response times).

Study Criteria

The City has used a response time criteria of 5 minutes average for the first-in unit and 8 minutes for the second-in unit. These average times are measured from the time a call is received at the 9-1-1 Center to arrival on the scene. (For the future, we recommend the use of percentile versions of response time criteria, e.g., 90 percent of calls responded to in 6 minutes or some other selected target.) An average can mask a situation in which a significant number of calls have high response times but are averaged with a number of

[1] It is beyond the current state-of-the-art to validly estimate the impact of changes in response time or the size of complement responding on the percent of fires contained to the room of origin or other containment measures, but the other factors can be addressed quantitatively.

calls close to the station. Averages are also much more susceptible to data errors; a single incident recorded as having a 70-minute response instead of a 7-minute response could distort the measure, but would have much less impact on a percentile measure.

The original RFP specified that the ISO rating must be retained at 3 or better. Since the last ISO rating was in the 70s, these criteria translated into not decreasing coverage or numbers of apparatus for this study. (The ISO rating was too out of date to use directly.)

The study also was predicated on maintaining at least the current level of safety practices for firefighters. This translated into considering the OSHA “two-in/two-out” requirement and the adequacy of staffing for various types of incidents, as well as the soundness of operation practices in general.

Finally, the RFP for the study specified the criterion that the department maintain at least its current staffing levels.

The overriding criterion was a desire to increase cost-effectiveness, or as the Canadians say, improve the “value for money.”

Methodology

TriData staff started the project with an intense “triage week” during which we visited Wichita and observed its stations, apparatus, and operations. Meetings were held with most of the senior Chiefs, the Information System Department, and the Planning Department. Discussions were held in several stations with a variety of the firefighters and officers. At the end of these visits, the project staff and City staff mutually triaged the issues, identifying the key areas of focus and the methodological approach.

The Wichita Fire Department (WFD) provided considerable background data on its operations both before and after the initial triage week.

The heart of the study was a number of station location analyses undertaken by the Wichita GIS staff under the guidance of TriData analysts. Using the network of streets in the GIS and locations of stations, a variety of analyses were made of existing response data and of coverage obtainable with different patterns of station locations.

A significant by-product of the study was the further development of the skills of the Wichita GIS staff to assist the Fire Department in station location analyses, and for Fire Department and Finance Department staff to work with the GIS staff in these analyses. It is hoped that the kind of analyses undertaken in the study will be feasible in the future on the City's own.

The analytical part of the study started with projections of demand. Demand was projected based on trend analysis of calls per capita and population projections. Demand was then disaggregated by area of the city to estimate impacts on different stations. The projected workloads and analysis of response times led to recommendations about the number and location of stations, units, and staffing. This methodology will be discussed in much greater detail in later chapters.

An initial draft report was reviewed in detail by the City, and further analyses were made. The resulting recommendations on station locations represent a consensus of TriData project staff and City officials. The other recommendations are those of TriData, after considering constructive comments from various reviewers.

Organization of this Report

The next chapter discusses the organization and operation of the Fire Department today, as a baseline. Chapter III addresses the demand forecast. Chapter IV presents a series of station analyses with associated maps. The maps, reduced to a size suitable for a report document, are better viewed in full size, and are available from the Data Center's GIS Department.

II. THE CURRENT SYSTEM

This chapter describes some key aspects of the department and its operations, evaluates the current level of service, and provides a few recommendations for improvement in management, organization, and communications.

The Department

The WFD serves the 337,000[2] residents of Wichita. The City, located in Sedgwick County, has a diverse economy that includes agricultural services, aviation, and oil and gas production. The City serves a large hinterland in central Kansas. The City owes some of its growth to its ongoing program of annexation. The City's population is expected to exceed 364,000 by 2010.

The Fire Department now covers 137 square miles of the City. As annexation takes place, the fire department will protect an even larger area and a larger population. This creates a challenge of maintaining service levels in the face of increased demand over a larger area. The Department provides a full range of fire, rescue, hazardous materials, and other services.

All but a few fire department personnel are trained at the basic life support level (including automatic defibrillation). The Fire Department is the first responder to most EMS incidents in the City. EMS transport is provided by the Sedgwick County EMS Department. The County ambulances are staffed with two paramedics. Occasionally the Fire Department provides a third person, and assists the paramedics in many ways when the two paramedics are not enough to handle the incident by themselves.

The Department cooperates with the Sedgwick County Fire Department to deliver services in fringe areas of the City. First-response agreements are in place and both organizations exchange resources on a routine basis. The number of responses given by the City to the County has been increasing. In 1997 the City gave 1,150 responses to the

[2] The population statistics originally used in this study were certified State of Kansas figures, which lag real population changes by several years. They were superseded in a communication from the City on December 29, 1999 that was based on the latest Planning Department estimates. We revised the report wherever possible to reflect the new data and note where we did not. Inaccuracy in population estimates comes from two prime sources: infrequent Census updates, and estimates of population in newly annexed areas. The discrepancies are small. Where possible the latest figures were used. They are higher than the original population estimate for 1998 by about 3 percent and less for the out-years.

County; in 1998 it was 1,288 and in 1999 about 1,450. The County responded into the City on 298 responses in 1998 and 233 responses in 1999. This long-term relationship is expected to continue. As the City annexes territory, some areas protected by County stations become the responsibility of the City. (Some areas being annexed already are served to a considerable extent by the City.)

The Fire Department has a staff of 388, most of whom are assigned to Operations (see Table 2.1). The Administration employees include chief officers, division heads, and clerical and vehicle maintenance staff. The Department's proposed 2000 budget is $23.5M.

Table 2.1: Wichita 1999 Fire Department Staffing

Assignment	Number of Positions
Administration	19
Fire Prevention	16
Operations	353
Total	**388**

The long-term trend data on staffing and activity levels are given in Table 2.2, and shown graphically in Figures 2.1 and 2.2. While incidents rose from 11,200 to 32,000, almost threefold, the Department's staff has declined from 421 to 388. Staffing was even lower in the 1980s. In the 1990s staffing increased from 366 to 388, still eight percent lower than 20 years ago. This pattern, while not unique to Wichita, indicates that existing resources are responding to demand for record levels of activity. However, the mitigating factor is that the nature of the service mix also continues to change, with more rescue (EMS) calls and fewer fires. The rescue calls require fewer units and fewer personnel per call than fires, which is why the situation has been tolerable.

Table 2.2: Trend in Incidents and Staffing

Date	Incidents	Staffing
1978	11,213	421
1979	11,790	410
1980	13,368	408
1981	16,585	397
1982	17,756	395
1983	17,954	391
1984	19,392	367
1985	19,424	367

Date	Incidents	Staffing
1986	19,829	367
1987	20,603	366
1988	21,578	367
1989	24,648	367
1990	24,989	367
1991	24,560	366
1992	24,763	383
1993	26,081	381
1994	26,168	380
1995	27,038	377
1996	27,540	377
1997	27,977	388
1998	30,360	388
1999	32,035	388

Figure 2.1: Trend in Incidents, 1978-1999

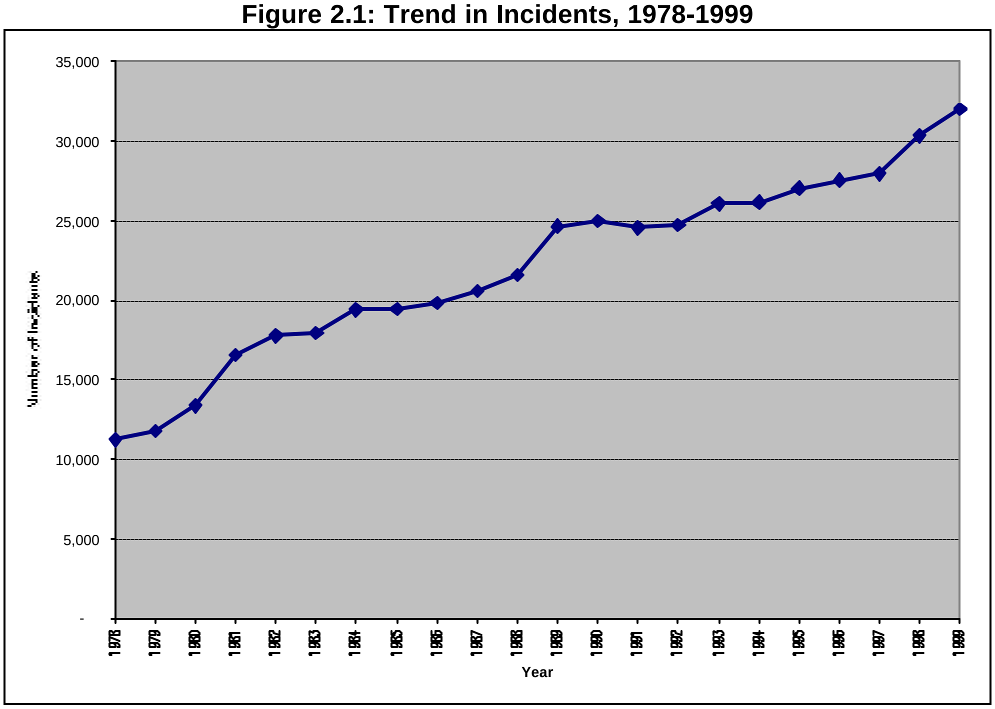
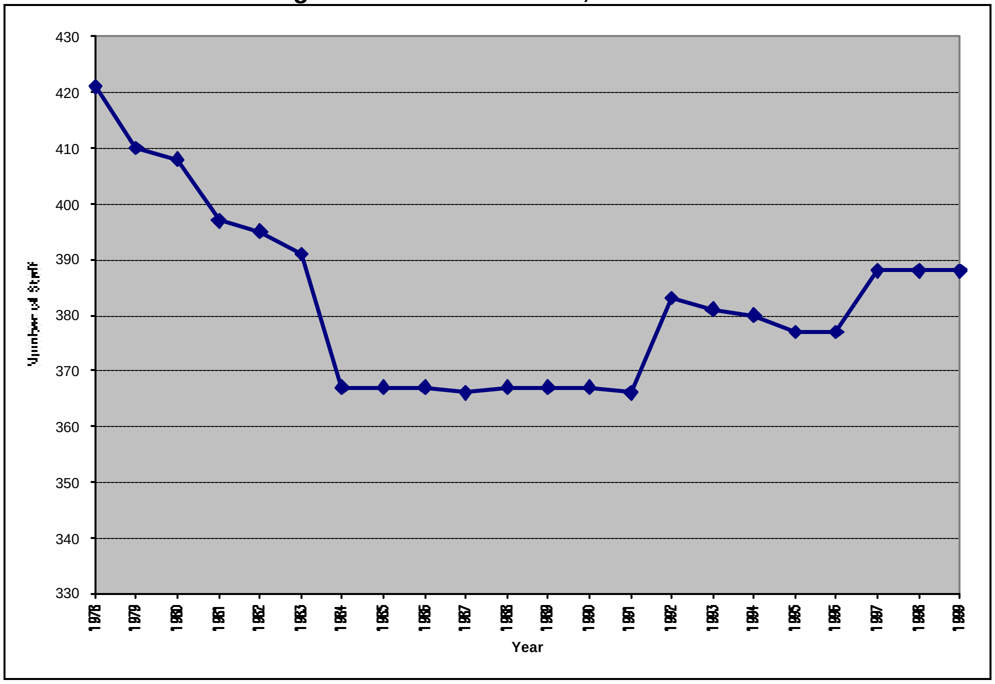


Figure 2.2: Trend in Staff, 1978-1999



The Department operates from 18 stations with a normal on-duty staffing of 100 personnel. The Department has an overall response time objective of 5 minutes on average for the first arriving unit and 8 minutes for the second. In 1998, the average response time for first-due units from dispatch to arrival on scene (i.e., including turnout and drive time) was 4:07. When call processing and dispatch time is added, which average about 54 seconds according to the 9-1-1 Center, the average overall response time (from receipt of call to arrival at the scene) is approximately 5 minutes. The Department is not able to track second-arriving unit response times.

The Department monitors its performance in terms of confining fires to the room of origin. This performance level runs at approximately 91 percent success over the past few years, quite good.

The fire risk levels vary throughout the city from low to high. Several areas that were recently annexed or are likely to be annexed in the near future are not equipped with fire hydrants, creating additional challenges for firefighting.

Operating Practices

The WFD has evolved a unique way of staffing for fire attack. The provision of some 15 two-person "squads" or quick response units are central to WFD operations. These squads are heavy-duty pickup trucks equipped with a “slip-in” pump (100 GPM) and tank (250 gallons). They are capable of supporting one attack line. These units are used as the primary response vehicles for EMS calls and are dispatched alone on outside fires such as vehicles, brush and rubbish. The availability of squads greatly reduces the response load on engine companies. This is a highly laudable and innovative practice followed by few fire departments. What makes this innovation feasible is the County-provided EMS transport; many cities have two-person squads, but they have to have patient transport capability (a box in the rear) instead of firefighting equipment.

Unit Staffing **–** Engine companies or quints are staffed with 3 personnel. Several ladder companies are operated on a cross-staffed basis by two personnel normally assigned to the Squads; they are seriously understaffed.

Three two-person units are designated as “rescues.” They carry basic equipment for vehicle extrication and specialized rescue. In addition, a heavy rescue truck is cross-staffed by personnel from Station 4.

Because of the relatively high workload for the squads, the ladder companies, which depend on cross-staffing by squads, are often slow to respond and at times are unavailable. This is particularly the case for the ladder companies at Stations 1 and 2, which serve the center of the City. Also, because quints can count as ladder companies for purposes of fulfilling the initial dispatch, responding to full fire assignments requires devoting some energy to determining which unit will be serving as the ladder company. If a quint is the first-arriving unit, it generally operates as an engine company, meaning that a later-arriving unit would act as the ladder company.

All firefighting units are under the command of an officer. Engines and quints are usually under Captains, while Lieutenants are in charge of Squads and Rescues.

Response Complement **–** The Department’s standard response for a house fire is 3 engines, 2 squads, a ladder , and a Battalion Chief. A safety officer and Battalion Chief respond on all structure fires. Commercial buildings get an additional engine company and high-rise buildings get an additional ladder (4 engines, 2 squads, and 2 ladders). Given the Department’s staffing profile, this equates to 15 firefighters and 2 command officers on house fires, 18 firefighters on commercial fires, and 20 firefighters on high-rise incidents. These are adequate first-due complements for light- and medium-hazards, but low by four for a high-hazard (high-rise); based on NFPA Fire Protection guidelines.

Safety **–** In addition to the firefighting apparatus, a battalion chief and safety officer respond on all full assignments. The Department has made a commitment to the safety officer role by providing personnel on a 24-hour on-duty basis for this function. These personnel are also tasked with functioning as the Department's Training Officers.

OSHA guidelines and NFPA guidelines and standards are playing an increasingly large role in firefighter safety, regardless of whether the state or local jurisdiction formally follows OSHA rules. There is a liability issue that is unclear but growing as to whether these rules constitute a professional standard. The current Wichita Fire Department practices are generally in compliance with the OSHA/NFPA guidelines (called the two-in/two-out rule) by designating two personnel from the initial alarm to act as a rescue team in the event personnel inside the fire building need emergency assistance. In the case of an engine arriving with its squad company, this role is fulfilled by the two personnel on the squad. The idea is to have two firefighters in full protective turnout gear including self-contained breathing apparatus (SCBA) ready to enter a burning building to rescue any personnel in trouble. An exception can be made when it is known that civilian lives are in danger.

Dispatching

Radio communications rapidly emerged as a major issue in our visits to the City. At present, the Department is dispatched by the Sedgwick County 911 Center. This Center also dispatches for Wichita Police, as well as Sedgwick County fire and sheriff, and several other smaller police departments. Numerous concerns were raised by the fire department about the quality of dispatches. The problems revolve around tracking unit status and location.

The fire dispatchers maintain the locations and status of units manually. Because of the complexity of fire department operations, units frequently are dispatched for an alarm and followed by corrections to the assignment because a unit status or location was not up to date in the dispatch system. This process of correction introduces delays in getting the appropriate number or closest units responding to an emergency, and should be minimized.

In practice, after a dispatch is made and a unit that feels they should have been dispatched recognizes this, they go to their apparatus and call the dispatcher and request that the assignment be corrected. If the unit calling in is correct, the dispatcher notifies it to respond, and cancels the other company, which can then go back into service. A related problem occurs when a unit that is intended to be dispatched on a call does not hear the transmission, and does not go.

Fire dispatching is a complex task, and even more complex for WFD than in many other departments. Some of the reasons for the complexity of the dispatch operation: quint companies can be assigned as an engine or ladder company; the units are constantly moving from location to location and playing various roles; the use of an extra category of unit (rescues); and the need to make a manual entry on the dispatch computer screen every time a fire department unit makes a change in status (such as going out of service for maintenance or becoming available after an incident).

Information about incident addresses has recently been improved by equipping company officers with pagers that give a written description of the incident address. But that does not improve dispatch time-keeping or tracking status of units.

Improved dispatch tracking of unit status and associated improvements in the accuracy of response time data have been achieved in many cities by use of electronic reporting devices mounted in the cabs of each fire vehicle. The simpler devices, called “modats” or “smart statusing,” allow a unit to report its status directly to the dispatch computer simply by hitting a button. The fire officer has to remember to do this, but that takes less time than a radio transmission and the results have been positive. The transmission avoids cluttering the airwaves, eliminates a task for the dispatchers, and accurately records the time.

A second technology that improves dispatching and data entry and offers other capabilities is the Mobile Data Terminal (MDT). Again, units would be able to enter their status by pushing a button in the vehicle that would automatically update the dispatch computer, without involving the dispatcher. The MDTs also allow basic administrative and operational data and messages to be sent from dispatch, and between or to fire companies and headquarters, without additional radio traffic. They also allow report preparation to start immediately. (They are highly useful for code enforcement personnel, too, who can send in notes from the field, and query a database.)

MDTs provide responding apparatus with the incident address, possible hazards, and sometimes response routes/directions. This can eliminate needless radio transmissions reconfirming addresses, and reduce the possibility of errors. It does more than the pagers do.

The technology for implementing MDTs is already installed in Wichita Police vehicles and in the Dispatch Center. The incremental costs primarily would be for purchase of the units for fire department vehicles.

Recommendation: Install electronic status reporting devices in fire department vehicles. These can be simple status reporters or MDTs. Moving to AVLs (automatic vehicle locators) would be even more desirable for optimal dispatching and real-time deployment management and accountability. They will reduce the workload on dispatchers and improve the accuracy of their knowing where units are, a critical factor in dispatch. They also improve reliability of response statistics. Accurate response time is critical for operational planning and station location decisions, as well as real-time decisions in dispatching based on the status of each vehicle.

If any future upgrades to the dispatch system are made, such as automatic vehicle location devices, then the fire department should be considered for that upgrade, too.

Current Service Levels

One of the purposes of this study was to assess the adequacy of the current service levels and resources. The need to assure cost effectiveness and efficiency were both identified as key concerns. The study identified several criteria for determining future station and unit needs: maintain or achieve an average first-due unit “response time” of 5 minutes; second response within 8 minutes (i.e., 3 minutes after the first unit arrives, a reasonable goal), and maintenance of current overall staffing and safety practices.

An average response time of 5 minutes means that a significant share of calls may not be reached within 5 minutes. In the case of a perfect bell-shaped distribution of responses, this would indicate that approximately half of responses took longer than 5 minutes. While the use of a percentile performance measure, such as 80 percent of calls in 6 minutes or 8 minutes might be more useful, an analysis of historic response time distributions should be undertaken before any new response objective is set.

The City’s Insurance Services Office rating was originally to be included as part of these criteria, but was not considered further because the City’s most recent study was completed in 1978, and the rating schedule has since changed. Rather than perform a complete analysis of the City along the lines of the ISO Rating Schedule, we applied our judgment to make what we felt were changes in line with the City's objectives and good practice.

As mentioned earlier, the WFD attempts to maintain an average first-due turnout plus drive time of 4:07 minutes to all alarms.[3] This response time was almost unchanged from 1997 to 1998. If call processing and dispatch time were included, the average total response times would be about five minutes, very good indeed.[4]

The turnout time (the time from receiving the dispatch notice to leaving the station) was reported by WFD to be 47 to 50 seconds on average, based on studies several years ago. This is quite satisfactory. The general standard is less than a minute on the average. (It may be faster during the daytime and slower at night).

In addition, the City tracks WFD performance with regard to the percentage of structure fires controlled within the area of origin.[5] Other end result performance measures include civilian deaths and injuries per 100,000 population and dollar loss per fire.

Response Times – The fire response time performance for 1998 is shown for each square-mile grid in the City on Figure 2.3. Each square is color-coded to show the percentage of calls reached within five minutes from the time the call was received to the arrival of the first unit on scene. Grids that are colored white or a shade of blue are those for which 50 percent or more of the responses were achieved within 5 minutes. Areas in orange have less than 50 percent of calls within 5 minutes.[6] Orange indicates areas where a 5-minute response was achieved for less than half the calls; the darker the orange, the worse the response performance. Similar maps were prepared for the years 1996 to 1997; the results were similar and not included here. These and subsequent maps in this report were prepared by the Wichita Data Center's GIS Department in consultation with TriData and the Fire Department. The maps plot actual response times taken from the Fire Department's incident reports.

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[3] A time estimate of 4:25 time was given in *Wichita Fire Department Performance Measures, 1999-2000-2001 Budget Submittal.*

[4] Dispatch time averages 54 seconds, as measured circa November 1999 by the Dispatch Center. (Personnel Communications, Carol McMillan, December 26, 1999.) That is good dispatch performance, only slightly above the 50-second goal used in the new IAFC Self-Accreditation Standards Manual.

[5] Spread after arrival was first proposed as an effectiveness measure by one of the authors of this report in 1976. It proved impossible to use because the spread on arrival cannot be measured unless the fire is very small, and often not even then because of smoke. As a substitute, the profile of "confined to" data on the NFIRS incident reports is examined and compared to other cities. WFD measures this by logging whether or not the burning was confined to the room of origin.

Ideally, 90 percent of calls should be within 6 minutes response time, which is similar but not identical to a 5-minute average fire response. Very few areas of the City are at that level. Many cities (e.g. Colorado Springs, Colorado for one) use 90 percent within eight minutes as their standard of coverage; Wichita is using a challenging criterion that is consistent with high performance for fire suppression and emergency medical response.

Overall, coverage is good in most of the City. However, the expansion of the City's boundaries has created several areas of less than satisfactory coverage. As the City continues to expand, these areas will grow larger, leading to diminishing response times citywide and unacceptable response times to increasingly built-up areas.

As one would expect, coverage is best in the center of the City, and poorest in some of the fringe areas of the City. The areas of deficiency with regard to first due response times are in the northwest, the southwest area near Mid-Continent Airport, the south central area, and part of the City's eastern boundary, as can be easily seen by the orange areas on Figure 2.3

Many of the areas of marginal response times are the areas likely to be annexed in the coming 10 years, indicating the possible need for added or reallocated response resources. One way to judge the importance of providing coverage in order to meet response guidelines is to consider the population protected and/or the number of calls in these currently marginal areas subject to annexation. [7]

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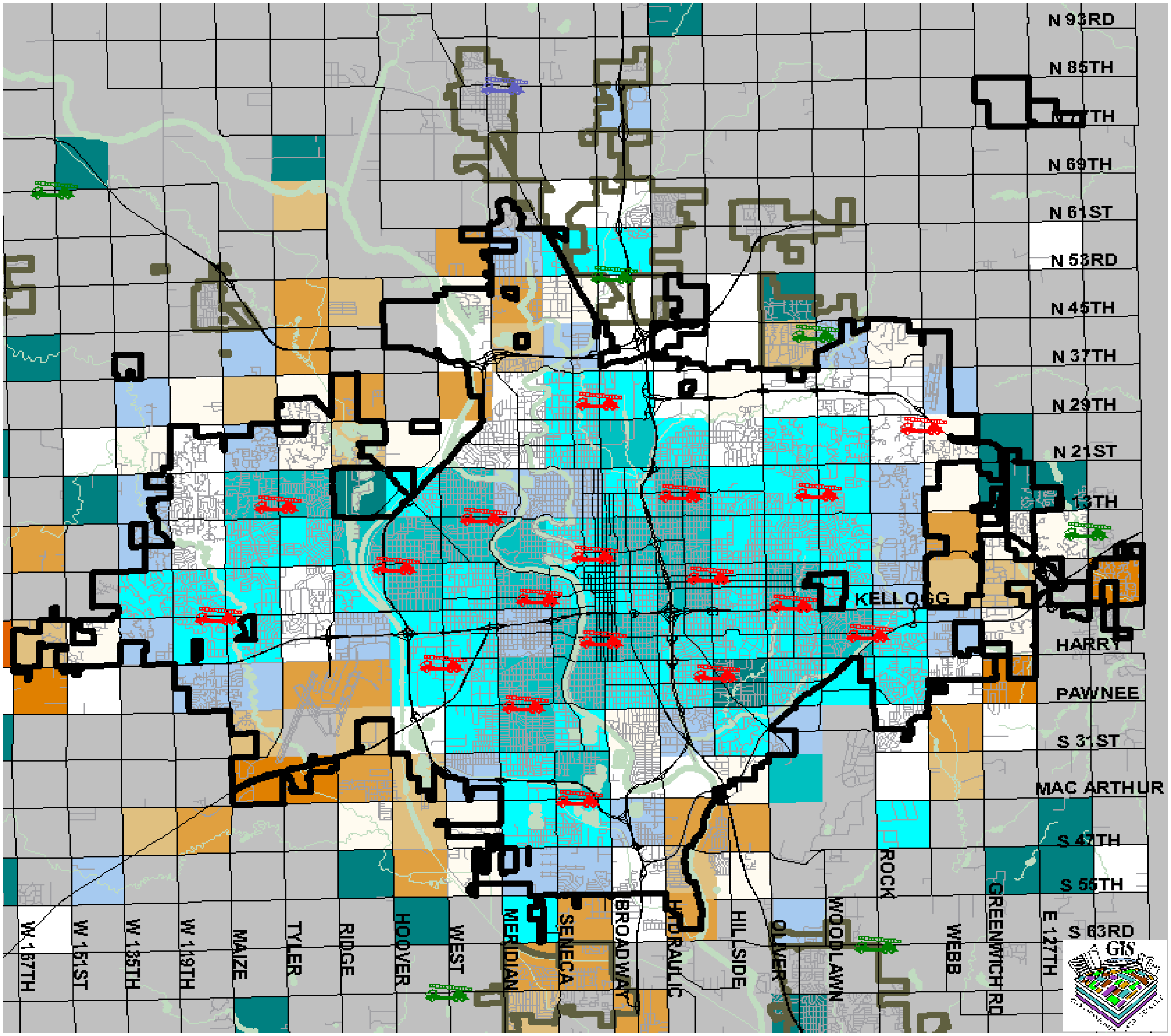
[6] The square areas of the map are slightly less than 1 mile by 1 mile, and are delineated by major streets.
[7] For the future, it would be good to produce an overlay on the map showing numbers of calls, especially in the areas with lower response times.

Figure 2.3



Percent of Calls within Five-Minute Response 1998

Blue = Over 60%
White = 50% to 60%
Orange = Below 49%

In addition to being remote from existing stations, some of the areas on the City's periphery have water supply deficiencies. Combined with slower response times, this creates a higher than normal chance of a significant loss in the event of fire. There are plans to improve water supplies in these newly annexed areas. Fortunately, the recent commercial development in these areas is equipped with fire protection systems and automatic sprinklers, which greatly reduces the risk.

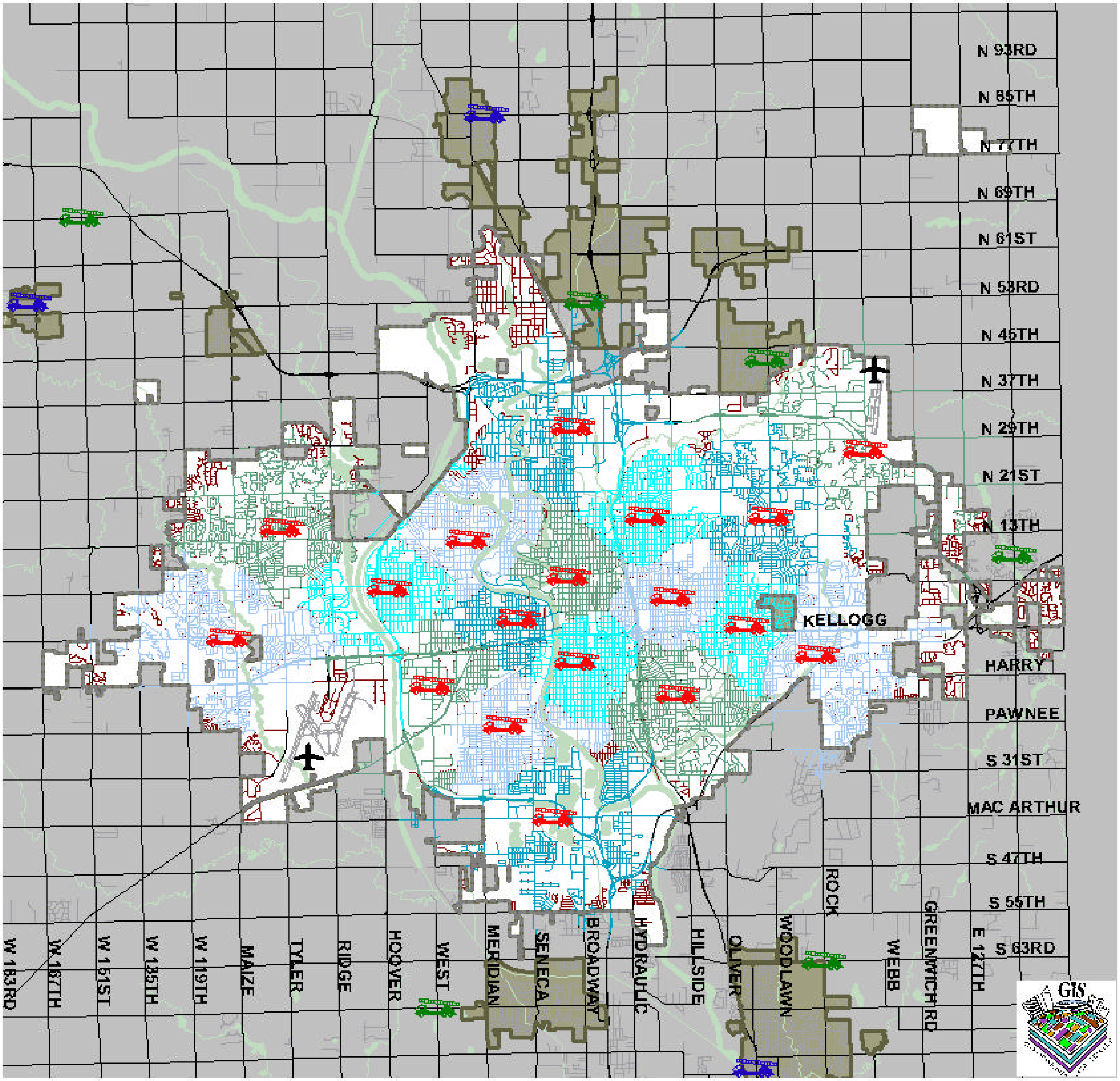
To examine coverage from another viewpoint, Figure 2.4 shows the area that is nominally within 6 minutes response time around each station. Areas that are white have no street network. Areas in the reddish brown color have no station within 6 minutes. These times include 2 minutes for call processing and dispatch, so they represent 4-minute drive times.[8] The 6-minute boundaries are derived by assuming fire vehicles can travel at the posted speed limit on each link in the street network until the 6-minute time limit is reached.[9] Typically, fire units average 25 to 30 mph in cities. The boundary between station coverage areas in Figure 2.4 is determined by which station can get to a given point first. The boundary between stations also represents where a station switches from first-due to second-due, or should, based on travel time calculations.

The map shows that there is good coverage in most of the City, consistent with the actual response times. But there are many pockets, mostly on the periphery that cannot be reached within 6 minutes.[10] Because fire units are used as first responders to all types of calls, the map applies to EMS responses as well as fire responses. As might be expected, the theoretical coverage is more optimistic than the actual coverage; some of the area in the south central boundary of the City are nominally within 6 minutes response but have over half their calls above that threshold. Though not included in this report, maps were developed as part of this analysis using a 5-minute response time to show where the holes in coverage first start to develop.

[8] More precisely, the GIS Department uses 4 minutes and 15 seconds for producing these drive time maps, on the basis that dispatch time averaged 54 seconds and turnout times 45 to 50 seconds.
[9] The Fire Department thought the assumption about driving at about the speed limit was a reasonable approximation. It varies by time of day, but was a reasonable average approximation.
[10] Note that the areas close to each station can be reached in less than 6 minutes. Only the boundary around each station is 6 minutes, and sometimes less if another station is closer than 6 minutes away. The average response times around each station would certainly be less than 6 minutes.

Only responses by City fire units, not those from surrounding departments were considered. Areas not within the City limits but that could be reached within 6 minutes by existing stations are shown.

Figure 2.4



Fire Response: Six Minute Coverage Area

Blue/Green = Good
Brown = Over 6 Minutes response

Ladder Truck Coverage – Figure 2.5 illustrates the areas within 8-minute response time by ladder trucks (including quints, aerials, and aerial platforms), within the City. The map assumes that the ladder companies by are in service. Because of the cross-staffing of ladder companies with quick response units, and the fact that a quint might be used as an engine in its first-due area, this map portrays a more optimistic situation than actually exists. But is still is useful to include the largest holes in coverage. Eight minutes was used here because the ladder companies are fewer in number than engine companies, and expected to be among the second-in companies in most cases.

The largest and most significant deficiency in ladder coverage is the north central part of the City. This area, roughly between Hydraulic and West Streets north of 29th Street, has long response times for ladder service. This can be a serious issue in terms of a timely response to commercial structure fires, situations in which an aerial device is needed, or for rescuing people from fires, a prime task of ladder companies. A second area of deficiency is the eastern boundary.

Analyses also were done for 6-minute response time of ladder companies to see where the holes in coverage first develop. Again for simplicity, they were not included here.

Structure Fire Responses – Another component in assessing the effectiveness of current resource allocation is to consider the location of structure fires in relation to resources needed to respond to them. Figure 2.6 shows where structure fires occurred in 1998 in terms of density of fires per square mile. The GIS software was used to develop the contours of structure fires per square mile. The not surprising finding is that structure fires are concentrated in central Wichita. Most of the areas of highest structure fire incidence are near fire stations and/or surrounded by others. In the remainder of the area protected, structure fires appear to be fairly uniformly distributed; every part of the City has some structure fires.[11]

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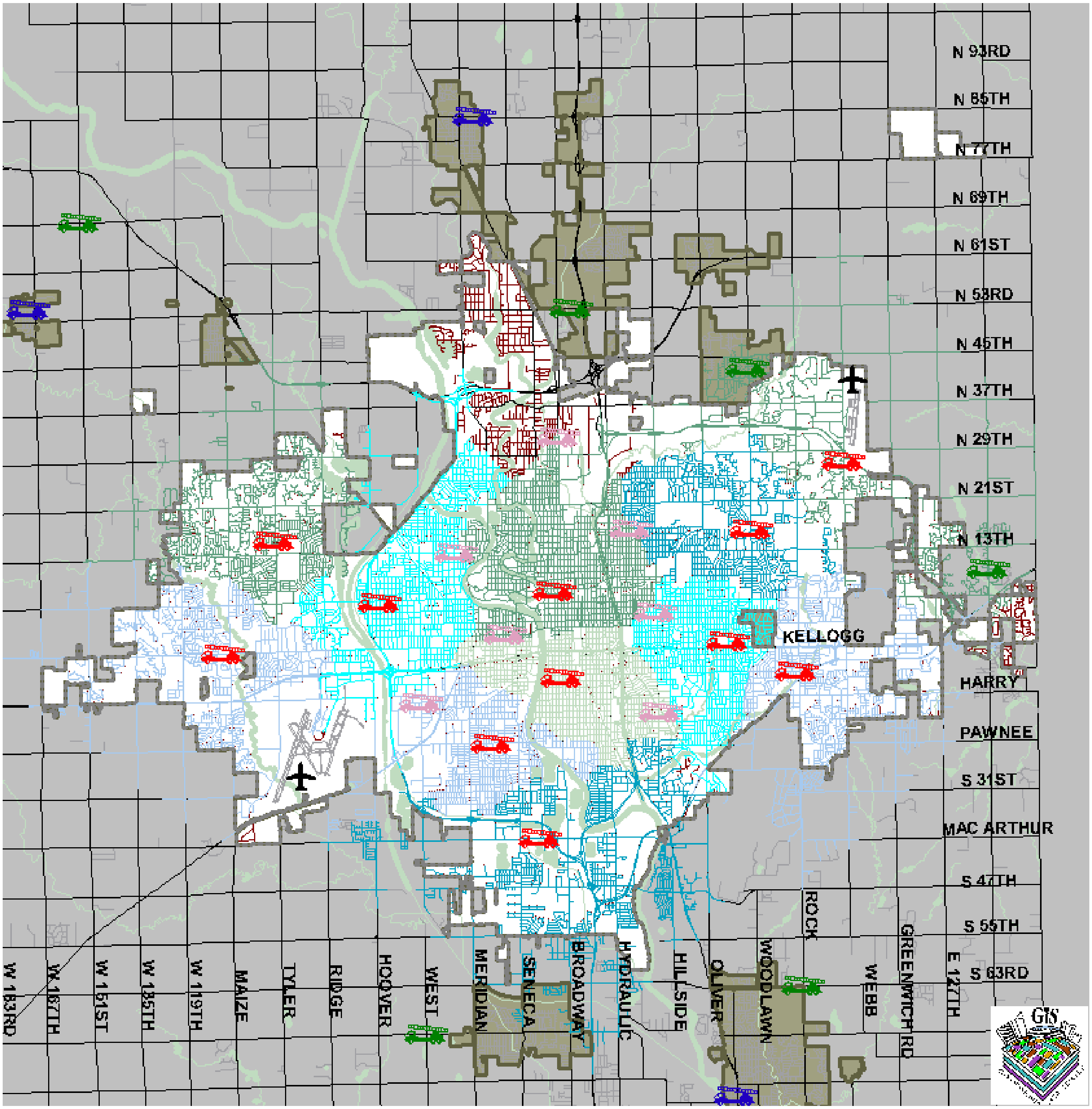
[11] For the future, it would be good to compute for structure fires the response times for the first-in units, second-in units, and arrival of total first-due complement.

Figure 2.5

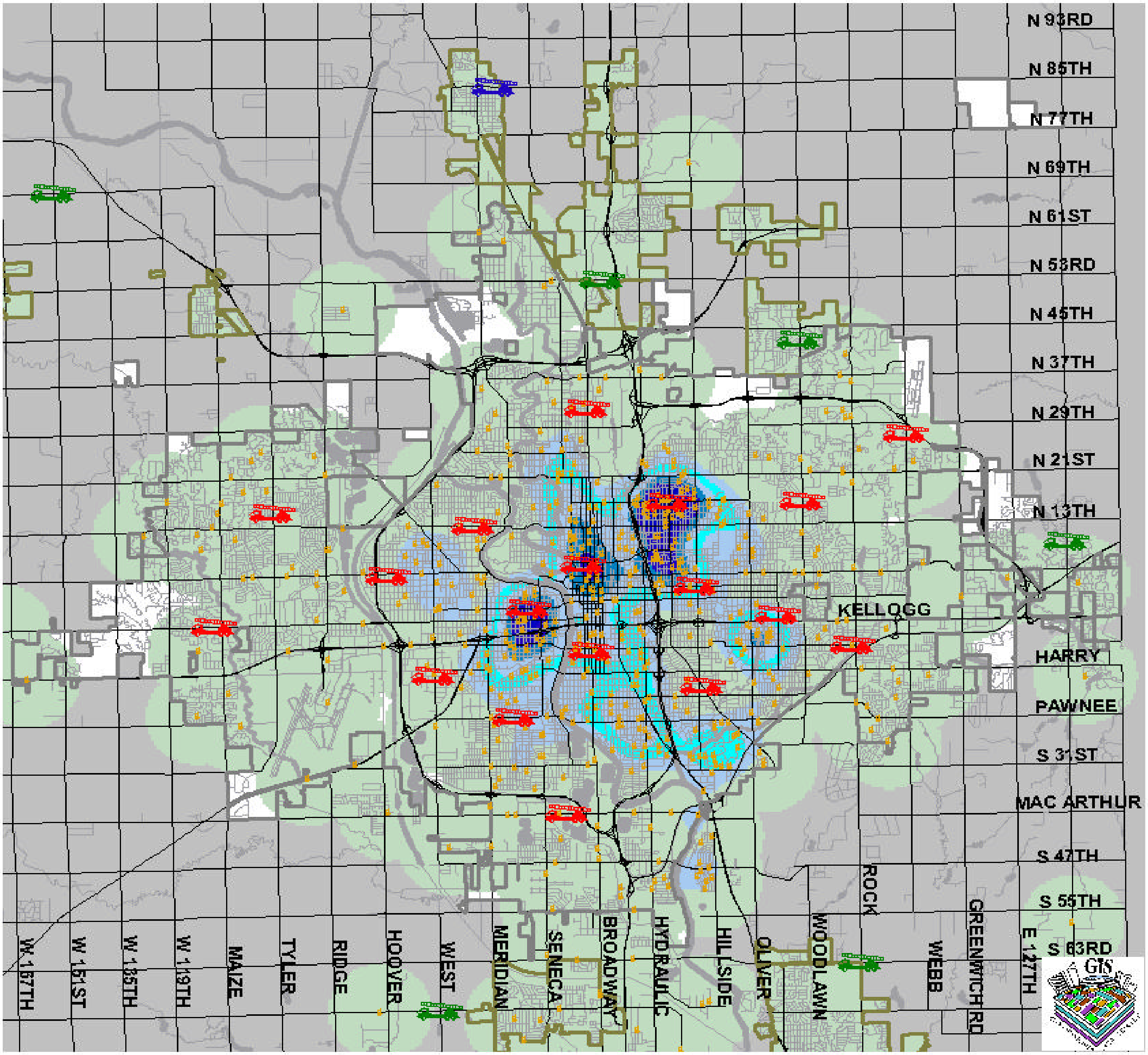


Fire Response: Eight Minute Coverage Area (Ladder Companies)

Blue/Green = Good

Brown = Over 8 Minutes response

Figure 2.6



Structure Fires 1998

Blue = High Density of fires

Reserve Apparatus – Reserve apparatus is used when a front-line piece goes out of service for mechanical problems or in the event of a major emergency in which off-duty crews are recalled to staff additional companies. The reserve apparatus needs to be in a state of readiness. While the Department has a number of reserve apparatus, they do not maintain these apparatus with a full complement of equipment. Rather, the equipment must be transferred from a piece going out of service to its replacement. That keeps the unit out of service longer than it need be. Also, in the event of a crew call-back, the Department does not have the ability to place additional companies into service immediately. Since reserve apparatus are used on an almost daily basis, it would improve efficiency at little cost to keep equipment on at least some of the reserve apparatus. Having a few reserve apparatus ready to go adds to the ability to keep the City protected during major fires or disasters.

Recommendation: Add ready reserve apparatus spaced throughout the City. About 4 spare engines, 2 ladders, and 1 to 2 squads would be appropriate to equip to have available to enter service on a short notice.

Intercity Comparisons

While fraught with dangers, intercity comparisons are interesting if only to ask questions about why there are differences. Table 2.3 presents comparisons of Wichita against six other cities in mid-America with populations of about 200,000 to 450,000.

In terms of employees per capita, Wichita is among the lowest in the comparison group, at 1.18 per 1,000 population. One factor may be the lack of providing ambulance transport, which is a time consuming function in other cities, but this is counterbalanced at least in part by the use of the two-person squads in Wichita.

The square miles served per station is on the low side, but the population served per station is much closer, suggesting the effect of higher density in Wichita.

The engine to truck ratio is in the middle of the group, but somewhat misleading, since cross-staffing is used for some ladder units in Wichita.

The workweek is the same as for the whole group.

Cost per capita is $65.65 in 1998, the lowest of the comparison group, though, again, it should be noted that this excludes ALS ambulance service, which is provided by the county.

No flagrant issues jump out from the comparisons. The low staffing raises questions of the level of service relative to others, but cannot be taken as an indicator of a problem per se. The next chapters delve more deeply into the satisfactoriness of the current resources and their deployment, and how well they are likely to hold up as demand continues to increase.

Table 2.3: Intercity Comparisons (1997-1998 Data)

City	Pop. (1998)	Area Served (Sq. Miles)	Uniformed Personnel	FD Employees	FF/ 1,000 Pop.	FD Employees/ 1,000 Pop.	# of Stations	Pop. Served/ Station	Sq. Miles/ Station	Engine Comp.	Truck Comp.	E/T Ratio	Shift Schedule	Avg. Work Week (Hours)	Op. Budget	FD Cost/ Capita	NOTES
Aurora, CO	245,000	135	283	320	1.16	1.31	11	22,273	12.3	11	3	3.7		56	$21,846,537	$89.17	ALS Engines at all stations; transport by Rural Metro (Aurora Medical Services)
Des Moines, IA	193,187	75	257	286	1.33	1.48	9	21,465	8.3	10	6	1.7	24/48 27 day cycle with overtime paid for exceeding hours; No Kelly	56	$16,000,000	$82.82	All ALS Transport; 6 ALS transport units, 10 BLS Engines
Omaha, NE	370,000	143	599	610	1.62	1.65	23	16,087	6.2	24	10	2.4	24/24 off (x5) then 6 days off	56	$46,972,163	$126.95	10 ALS Transport Units, 7 ALS Engines
Tulsa, OK	384,000	192	700	726	1.82	1.89	30	12,800	6.4	30	6	5.0	24/48 with "City Shift" (Kelly) every 13 shifts	52	$44,000,000	$114.58	First Responder for Life Threatening Emergencies -- Private EMS Transports; In addition to Engines and Ladders there are 4 quints in the city
Tucson, AZ	465,900	194	483	520	1.04	1.12	17	27,406	11.4	18	6	3.0	24/24 off (x5) then 6 days off	56	$34,425,000	$73.89	First Responder with X-Port Capabilities; Most transports by private ambulance
Albuquerque, NM	436,000	163	537	565	1.23	1.30	19	22,947	8.6	19	5	3.8	48 on/72 off	56	$33,000,000	$75.69	Private Ambulance Transport
Colorado Springs, CO	341,000	189	342	383	1.00	1.12	17	20,059	11.1	17	5	3.4	24 on/off/on/off/on/4off	56	$26,800,000	$78.59	No ALS Transport
Wichita, KS	329,000	136	348	388	1.06	1.18	18	18,278	7.6	18	6	3.0		56	$21,613,097	$65.69	Ladders Not Fully Staffed

III. DEMAND FORECAST

Among the key tasks of this study was to estimate the future demand for fire department service throughout the City of Wichita over 5- and 10-year forecast periods. The process and results of estimating future demand are described in this chapter.

As the City continues to annex territory and development continues, the demand for fire and emergency medical services obviously will be affected. The growth of the City in area creates difficulties in response time, and the increasing population creates a higher demand for service for all types of incidents.

A Note on Methodology – The forecast uses several sources of data to develop an analysis of future trends in demand, the effect on unit workloads, and the probable need for additional units and stations.

The initial pass at making these forecasts was based on State estimates of Wichita population. Toward the very end of the study, newer forecasts by the Planning Department were provided as published in the City of Wichita's "The Development Trends Report." The largest change in the population estimates were for 1989 (up 10K) vs. a 6K increase in 1998. These 2 to 3 percent changes do not affect the results significantly. We revised the initial tables in this chapter, but could not easily revise the later, more complex analyses. Increasing the population decreases the per capita demand rates (same incidents, larger denominator). So the per capita rates would be lower than projected, but the total population would be higher, and projected demand is the product of these two factors. To be conservative, and as a sensitivity analysis, we added an extra column to the later analyses that show an extra 10 percent in demand. We also include in the Appendix the detailed original data we used for the estimates.

Past Trends

Table 3.1 shows estimates of the resident population protected and the number of incidents by type for the City of Wichita for the past 11 years (1989 to 1999). The 1999 data became available just as this report was being finalized, and was not used in the demand projections. The population of the City increased by 10 percent over the 10-year period 1989 to 1998, growing from about 298,000 to about 329,000. Much of this growth is attributable to annexations by the City. The annexed areas are being developed with mixed uses, including moderate density housing, shopping, and office complexes.

Table 3.1: Resident Population Served and Calls for Service, 1989-1999

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Population (000's)	298.33	304.02	309.44	315.20	318.04	318.51	318.40	320.40	323.62	329.21	337.00
Fires	2,112	1,926	2,046	1,591	1,747	1,964	1,734	2,079	1,588	1,670	1,376
Rescues	16,969	17,982	17,935	18,377	19,493	18,821	19,852	19,088	19,428	20,561	21,846
Hazardous Conditions	1,591	1,733	1,338	1,308	1,252	1,303	1,205	1,208	1,084	1,401	1,478
Service Calls	631	433	366	335	371	480	619	709	865	798	905
Good Intent Calls	2,181	1,974	1,873	1,869	1,844	2,101	2,393	2,591	2,273	2,771	3,177
False Alarms	352	341	376	478	510	517	561	674	960	936	1,139
System Alarms	812	600	626	805	864	982	944	1,191	1,779	2,223	2,114
Total Calls	**24,648**	**24,989**	**24,560**	**24,763**	**26,081**	**26,168**	**27,308**	**27,540**	**27,977**	**30,360**	**32,035**

The call categories used here conform to the National Fire Incident Reporting System (NFIRS) definitions, with the exception of false alarms, which are appropriately divided into two categories: one reflecting automatic detection system-related alarms and the other including various other types of false alarms. To make comparisons with other jurisdictions it may be useful to combine these two categories.

The number of incidents reported to the WFD increased by almost 6,000 from 1989 to 1998 going from 24,648 to 30,360. That is an increase of 23 percent, 100 percent faster than the growth in population, which rose 10.4 percent. Thus about half of the increased call volume is attributable to greater demand per capita, and the rest to annexation.[12]

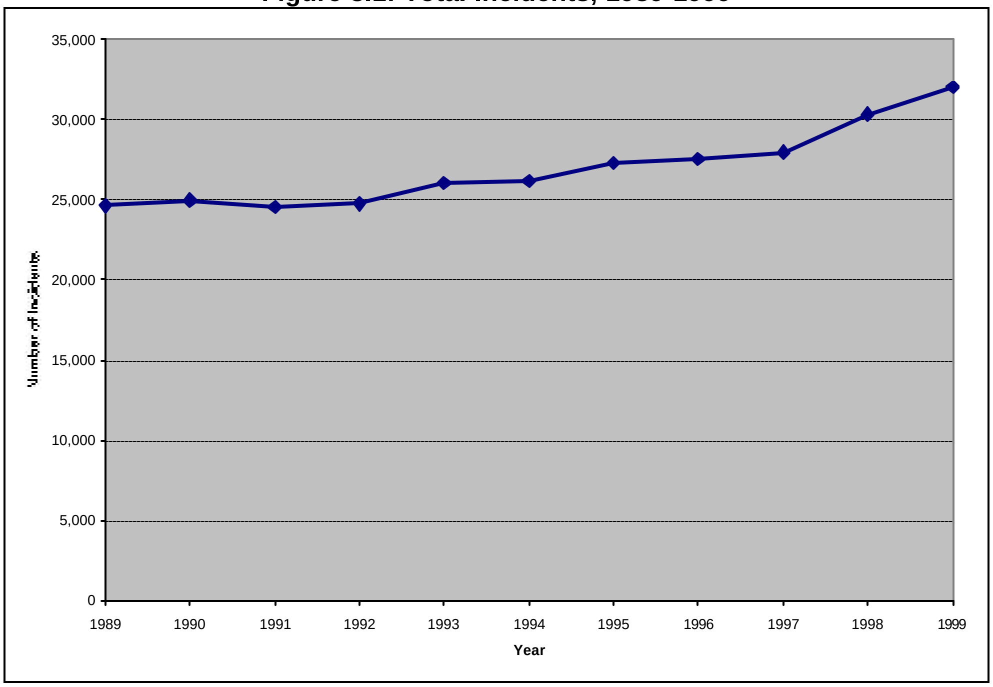
As Table 3.1 indicates, most types of calls for service increased over the past 10 years. EMS (rescue) incidents, the largest category, increased about 25 percent, accounting for much of the overall increase in calls since 1989. Fire calls decreased over the past 10 years, but they fluctuated considerably year to year, indicating that there is not yet a clear trend. Both false alarms and system alarms have almost tripled since 1989 – by far the fastest growing category of calls. Possible explanations for both of these developments will be discussed later in the report.

Total incidents over the past 10 years are shown graphically in Figure 3.1. Overall, the trend has been one of a steady but modest increase at an average rate of about 2 percent per year. However, there was an 8.5 percent jump in demand from 1997 to 1998, larger

[12] We suggest that data on demand per capita in newly annexed areas be captured in the future to see if these areas are proportionately greater or lesser burdens than the rest of the City. The 2000 Census will provide a benchmark on the accuracy of the detailed estimates of population in those areas.

than the estimated percent increase in population, and another jump in 1999. If that increase turns out not to be a data artifact, the nature of the increase – type of call, time of day, area of City, etc. – should be investigated to understand its cause. A sustained rate of increase in demand at that level is unlikely, but cannot be ignored.

Figure 3.1: Total Incidents, 1989-1999



At this initial stage of the analysis, we begin to see the direction of changes taking place in the City. Demand is rising, but gradually. This implies that future needs for added equipment may be driven primarily by the need to maintain coverage (adequate response times to newly developed areas), rather than because of excessive numbers of responses overloading individual units. (More will be said about this later.)

Forecast Methodology

Two sets of forecasts were produced in this study – a lower bound and an upper bound estimate. To estimate the number of calls for service going into the future, we started with basic information on historic demand, population growth, and population projections. We also examined the calls per capita over this same 10-year time period.

The population of the City increased by about 31,000 in the 10-year period 1989 to 1998, and by another 8,000 in 1999 (Figure 3.2). The increasing demand must be considered in light of this changing population. Population reached 337,000 by 1999, and is projected to reach 347,000 by 2005, and 364,000 by 2010.

Figure 3.2: Resident Population, 1989-1999

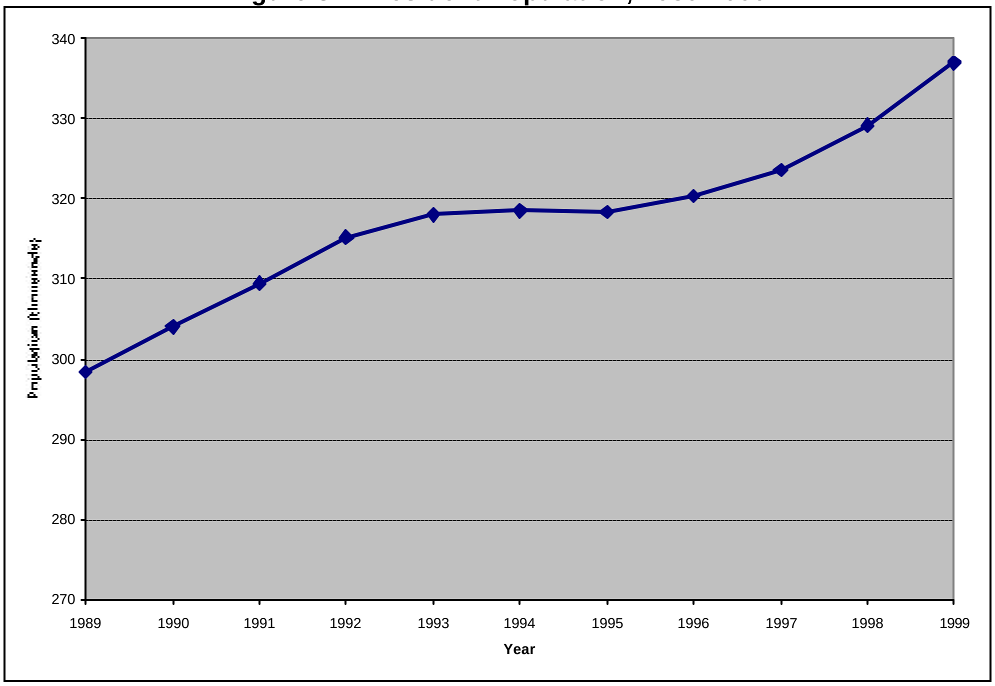


Table 3.2 shows the trend in calls per capita by type of call. Overall, calls per capita increased significantly, by 12 percent over the decade 1989 to 1998. The calls per 1,000 population rose from 82 to 92.

Table 3.2: Trend in Calls per 1,000 Population by Type, 1989-1999

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Population (000s)	298.33	304.02	309.44	315.20	318.04	318.51	318.40	320.40	323.62	329.21	337.00
Fires	7.08	6.34	6.61	5.05	5.49	6.17	5.45	6.49	4.91	5.07	4.96
Rescues	56.88	59.15	57.96	58.30	61.29	59.09	62.35	59.58	60.03	62.46	64.82
Hazardous Conditions	5.33	5.70	4.32	4.15	3.94	4.09	3.78	3.77	3.35	4.26	4.39
Service Calls	2.12	1.42	1.18	1.06	1.17	1.51	1.94	2.21	2.67	2.42	2.69
Good Intent Calls	7.31	6.49	6.05	5.93	5.80	6.60	7.52	8.09	7.02	8.42	9.43
False Alarms	1.18	1.12	1.22	1.52	1.60	1.62	1.76	2.10	2.97	2.84	3.38
System Alarms	2.72	1.97	2.02	2.55	2.72	3.08	2.96	3.72	5.50	6.75	6.27
Total Calls	**82.62**	**82.20**	**79.37**	**78.56**	**82.01**	**82.16**	**85.77**	**85.96**	**86.45**	**92.22**	**95.94**

The per capita rates show a fluctuation over time for almost all categories of calls. There was a general trend of increase for Rescue (EMS), Good Intent, False Alarms, and System Alarms. There was a slow decrease in per capita calls for fires. Service calls per capita appear to be steady, or trending slightly upward, with considerable year to year fluctuation. Finally, hazardous condition calls per capita appear to be trending downward over the decade, but fluctuate a great deal year to year.

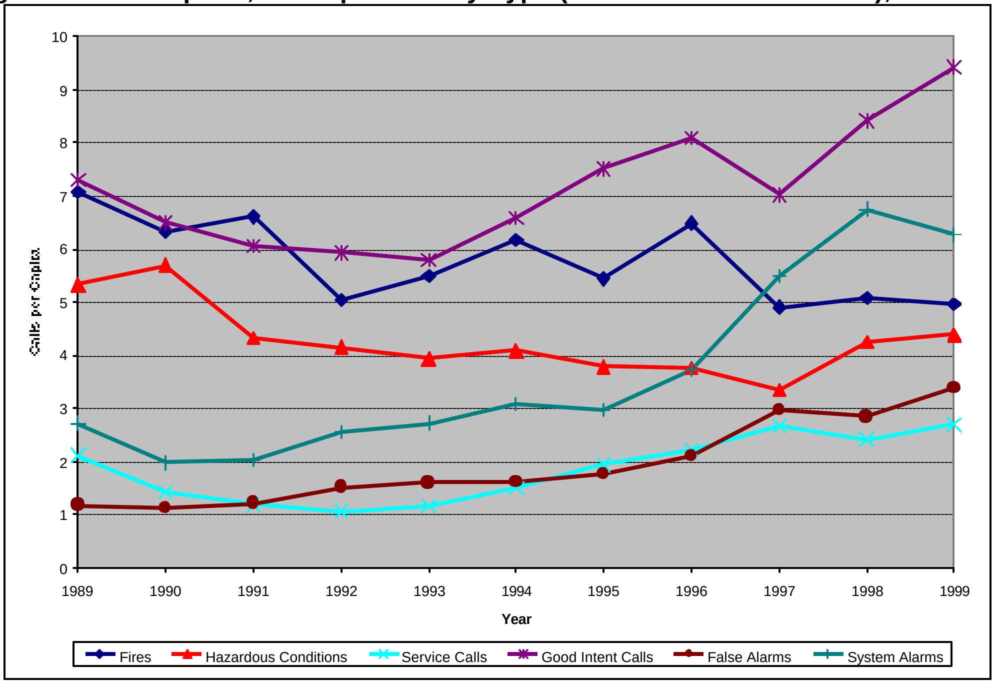
This pattern is not uncommon. The citizens are using EMS more and more, probably because the combination of a gradually aging population and increasing awareness of (and satisfaction with) emergency medical services. System (false) alarms are increasing as the number of automatic alarm systems increase with new construction covered by modern building codes. The reliability of alarm systems and their maintenance is a growing problem for the fire service.

Use of this information allows differentiating growth in demand stemming from population increase from the growth caused by increased use of service. Growth in demand is caused by a combination of increased population and economic activity and from higher utilization of fire and rescue services from the public (people more willing to call the fire service or use EMS).[13] It is also comes from widespread adoption of automatic fire alarms, which produce more responses merely by their presence. Some of the increased demand per capita from residents may be caused by increased calls from commerce and industry.

The trend in calls per population by type is illustrated in Figure 3.3. Rescue calls are omitted to show greater detail for the other call types.

[13] It would be useful to undertake an analysis to estimate the proportion of EMS calls coming from non-resident workers, visitors, and people traveling through. It can be based on the residential addresses given by patients. This data was not readily available but could be analyzed in the future even by hand, for a random sample of several hundred calls. It would indicate whether the non-resident portion of EMS is significant, and whether trending upward or downward. That would be of interest in itself, and help in projecting future demand.

Figure 3.3: Calls per 1,000 Population by Type (Other than Rescue Calls), 1989-1999



To compute the rate of growth in calls per capita over time, the rates of calls per 1,000 population were divided by the previous year's values to determine the percentage change from one year to the next. Table 3.3 shows calls per capita expressed as a percent change from the previous year. Ratios greater than one indicate an increasing rate of calls per capita while ratios less than one show a decrease. The average rate of change in calls per capita from 1989 to 1998 was highest for system alarms and false alarms, which both increased in excess of 10 percent annually on a per capita basis.

Table 3.3: Call Growth Rates per 1,000 Population
(Expressed as Ratio to Previous Year)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	9 Year Avg.	1999*
Fires	0.89	1.04	0.76	1.09	1.12	0.88	1.19	0.76	1.03	0.98	0.98
Rescues	1.04	0.98	1.01	1.05	0.96	1.06	0.96	1.01	1.04	1.01	1.04
Hazardous Conditions	1.07	0.76	0.96	0.95	1.04	0.93	1.00	0.89	1.27	0.98	1.03
Service Calls	0.67	0.83	0.90	1.10	1.29	1.29	1.14	1.21	0.91	1.04	1.11
Good Intent Calls	0.89	0.93	0.98	0.98	1.14	1.14	1.08	0.87	1.20	1.02	1.12
False Alarms	0.95	1.08	1.25	1.06	1.01	1.09	1.19	1.41	0.96	1.11	1.19
System Alarms	0.73	1.03	1.26	1.06	1.13	0.96	1.25	1.48	1.23	1.13	0.93
Total Calls	**0.99**	**0.97**	**0.99**	**1.04**	**1.00**	**1.04**	**1.00**	**1.01**	**1.07**	**1.01**	**1.04**

* Though included here for interest, the 1999 data became available too late in the study to be used in the forecasts..

Fire Incidents – The public sometimes mistakenly thinks that the major source of demand for the fire service is fires. "Fires" here include only working fires or incidents in which there was fire damage. They decreased slightly per capita over the past 10 years. This is consistent with experience in other mature cities. The ratio of fires per capita from one year to the previous year fluctuated between a low of about .76 and a high of 1.19 (i.e., a 24 percent decrease to a 19 percent increase). We do not expect any major increase in fires per capita in the future. As a share of total responses, we expect fires to become a smaller share of the total call volume as other incident types continue to increase (1999 continued the drop in fires per capita).

EMS/Rescue Incidents – EMS incidents include medical emergencies and automobile accidents with injuries. Public education campaigns and general increasing expectations from the public have contributed to higher utilization of EMS in most fire and EMS departments. The EMS system also serves in some measure as the health care of last resort for the uninsured. The extent to which this is the case in Wichita is uncertain, but it does not appear to be a major issue. Because EMS calls are so large in number, any increasing utilization of these services on a per capita basis has major consequences for the overall demand for service. We expect that EMS demand will continue to increase in the future. As shown in Table 3.3, rescue incidents had a positive rate of growth per capita in most years.

Hazardous Conditions – Hazardous condition calls are those incidents which could but did not cause a fire or medical incident, but require fire service attention on an emergency basis until they are resolved. Hazardous conditions include releases of natural gas, flammable liquid spills with no fire, hazardous materials incidents, and electrical wires down. Hazardous condition incidents had an average rate of decrease of 2 percent per year per 1,000 population.

Service Calls – Service calls are those incidents that are not strictly defined as emergencies, but receive a fire or EMS response and some action. This can include incidents such as assisting people who may have fallen out of bed, broken water pipes, or any of a number of unusual scenarios including animal-related rescues and assisting the public with access to locked vehicles or buildings. Service calls per capita grew at an average rate of 4 percent with large increases from 1994 to 1997.

Good Intent – Good intent calls are those for which a citizen reports an emergency, but on arrival of the fire services, the situation in question is not an emergency. Good intent calls tend to increase as people get “trained” to call the fire service to report emergencies. The presence of cellular phones makes reporting emergencies easier for the public, and probably has increased such calls. Cellular phones also increase the multiple reporting of calls, especially from a road accident. After decreasing for most of the base period, the per capita rate increased after 1995, resulting in a 10-year average growth rate of 2 percent. Continued growth is expected to continue.

False Alarms – False alarms increased dramatically over the period. In absolute terms, they more than doubled in the last 10 years. Not only is the number of alarms increasing, but the number of alarms per 1,000 population is also increasing, by 11 percent per year on the average, and even higher in 1999. The reasons for this increase in false alarms is not clear.

System Alarms – These automatic detection system alarms are increasing due to a combination of two factors. Commercial development and new construction built to modern codes require built-in automatic alarm systems, which leads to more alarms in new buildings than in older buildings that did not require these systems. Second, as new alarm systems come into regular service, they undergo a period of adjustment in which it is not uncommon to experience numerous false alarms. Both mechanisms are likely at work here. The number of system alarms increased an average of 13 percent per year on a per capita basis over the base period, though showed a decrease in 1999 for the first time in a decade.

Optimistic and Pessimistic Forecasts

Because of the inherent uncertainty in predicting the future (due to both population change and per capita utilization of services), two forecasts were produced. These are termed optimistic and pessimistic. The lower bound or optimistic forecast assumes that the per capita demand for service will not increase over the forecast period; demand will increase just in proportion to population. This is an appropriate assumption in cases where delivery systems are mature and there is clear indication that per capita rates per incident type are stable (have leveled off) or are declining. While there is some instability in the rate of increase for certain types of incidents, the overall rate of growth in calls for service per capita in Wichita is fairly steady (about 1 percent per year).

The forecasts are based on population and per capita demand for service. The per capita figures include demand for service both by visitors and employees who work in the City but do not live there (per capita rates are computed as calls from all sources divided by resident population). Wichita planners do not expect a major change in the underlying ratio of business to residential population over the forecast period, meaning that past per capita figures should reflect business in the future to about the same extent as they have in the past, especially for the next several years.

For both the optimistic and pessimistic forecasts, the trend in each type of incident is predicted individually, and the resulting forecasts added together to produce an estimate of total calls for service. The use of separate sub-forecasts allows for capturing the differential growth rates of different incident types, and permits a more detailed analysis of future demand in terms of resources needed.

In the optimistic forecast, we assume that per capita rates for each incident type are fixed at a rate based on the 1989 to 1998 base period. In the pessimistic forecast, we assume that there will be an increase in per capita demand for all call types except for those call types that had been decreasing per capita in the past decade, i.e., fires and hazardous conditions. The latter two were held at their 1998 per capita rates. For each scenario, two forecasts were produced – a 5- and 10-year forecast.

Growth patterns are fairly well defined for the future. Data provided by the City and the Wichita-Sedgwick County Metropolitan Area Planning Department were used as the basis of future annexation, development, and population trends. This reduces the uncertainty associated with the location of development and overall population levels.

2000-2005 Forecasts

***Optimistic Forecast (No Growth in Per Capita Demand)* –** The 5-year forecast assumed stable per capita demand for service. For some incident types, this assumption is probably not warranted. However, because this forecast is intended to provide a minimum or lowest likely demand scenario, it is appropriate.

The 1998 per capita figures were used for all incident types.[14] This means that any increase in demand is attributable solely to population increase. Population figures were

[14] Actually, the 1998 rates used were those computed with the slightly lower initial population estimates we were provided for the past 10 years, and so were 1 to 2 percent higher than the rates in Table 2.2.

drawn from the latest planning data.[15] The five-year optimistic forecast is presented in Table 3.4.

Table 3.4: Incidents by Type, Optimistic 5-Year Forecast

	2000	2001	2002	2003	2004	2005
Estimated Pop. (000's)	343.30	346.70	350.20	352.83	355.47	357.96
Fires	1,773	1,791	1,809	1,823	1,836	1,849
Rescues	21,835	22,052	22,274	22,441	22,609	22,768
Hazardous Conditions	1,488	1,503	1,518	1,529	1,540	1,551
Service Calls	847	855	865	871	878	883
Good Intent Calls	2,943	2,971	3,002	3,024	3,047	3,068
False Alarms	994	1,004	1,014	1,022	1,030	1,037
System Alarms	2,360	2,384	2,409	2,426	2,445	2,461
Total Calls	**32,241**	**32,560**	**32,890**	**33,136**	**33,384**	**33,617**

In this optimistic forecast, the total number of incidents will increase by approximately 3,200 incidents between 1998 and 2005 – slightly over 10 percent.[16] As said before, this represents a conservative estimate, and assumes that no growth in per capita demand will take place. The City population is estimated to be 358,000 in 2005. These optimistic estimates should be taken as a lower bound on demand that is likely to be exceeded. Just before this study was published the 1999 data become available, and were just below the estimate for year 2000.

Pessimistic Forecast – In the pessimistic forecast, an assumption was made that per capita rates of calls would continue following the past trends if increasing, or stay the same if their rates had been declining. Judgment was used to establish this forecast as a pessimistic or worst case scenario. Each type of call was evaluated individually, based on its past performance and expected behavior in the future.

For most incident types, the 10-year average growth rate in per capita demand was used.[17] We started with the base number of incidents defined by the 1998 per capita rates, multiplied by the annual rate of growth in rates, multiplied by the estimated population to obtain the expected number of incidents. For each succeeding year, this growth rate was applied again, resulting in a compound growth rate.

[15] Wichita-Sedgwick County Metropolitan Area Planning Department. *Development Trends*. May 1999.
[16] This level, predicted from a 1998 base, may already have been exceeded by the end of 1999.

The only two incident types that did not rely on 10-year averages for annual growth in per capita demand were fires and hazardous conditions, which had negative average growth rates over the 10-year base period. Instead, these call types were assumed to remain constant in per capita terms at their current (1998) level.

For system alarms, the high annual growth rate was assumed to peak in 2005 and remains constant thereafter. This is designed to capture the likely reduction in system alarms once new systems have undergone a "break-in" period, coupled with enforcement activity on systems with excess alarm activations. Carrying a 12 to 13 percent growth rate per capita out beyond 2005 produces unrealistically high numbers of system activations.

Table 3.5 presents the results of the pessimistic forecast for 1999 to 2005. The effect of continued per capita growth in demand is noticeable. Total incidents exceed 39,000 by 2005, an increase of almost 9,000 incidents (over 29 percent) from 1998 levels. Most of the difference in the optimistic and pessimistic forecasts is attributable to system alarms and EMS/rescue.

The right-most column in Table 3.5 shows the pessimistic projection with another 10 percent added. This allows a sensitivity analysis to be made of resource requirements for the possibility of demand being even higher than the pessimistic projection. We also added this column because the actual 1999 demand per capita jumped another 4 percent over 1998, after 1998 jumped 7 percent over 1997. If this short-term trend continues, it would create a need to increase the base of projection. The extra 10 percent also provides a margin of error for what the revised per capita rate projections would have produced if we had computed them for the minor changes in population estimates made late in the study for 1989 to 1998 (and hence it is a more conservative estimate). However, it is unlikely that demand would continue to increase at a compounded rate when population increase is projected to average only 0.8 percent per year for 2000 to 2005 and 0.3 percent per year for 2005 to 2010.

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[17] As in the optimistic forecast, these rates used were based on the slightly earlier population estimates for 1989 to 1998, and hence were a few percent higher than shown in Table 3.2.

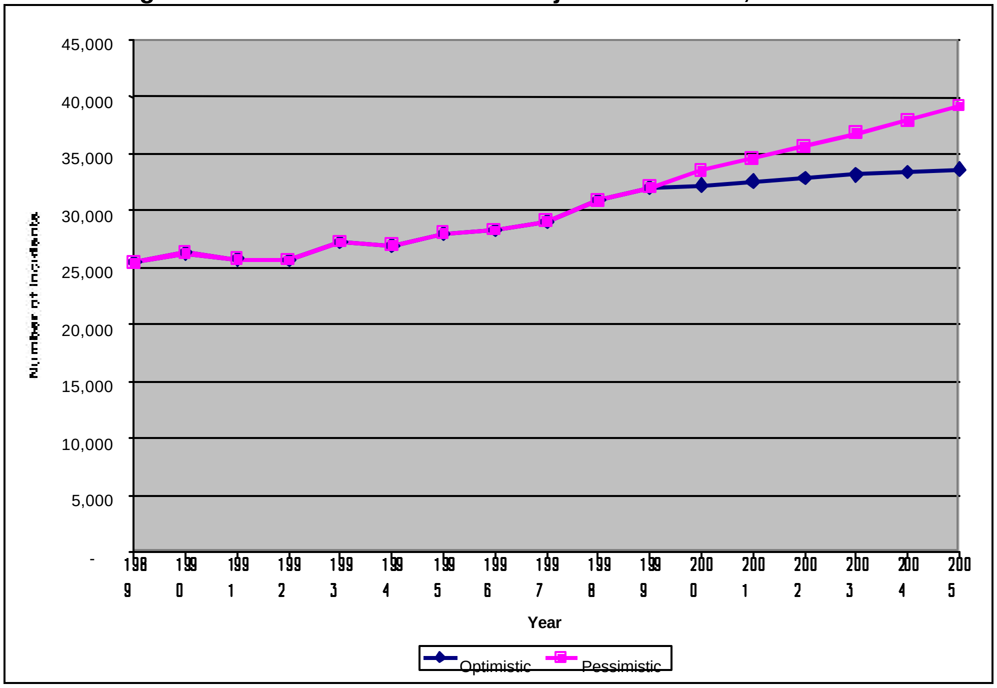
Table 3.5: Incidents by Type, Pessimistic 5-Year Forecast

	2000	2001	2002	2003	2004	2005	2005 + 10%
Estimated Pop. (000's)	343.30	346.70	350.20	352.83	355.47	357.96	
Fires	1,773	1,791	1,809	1,823	1,836	1,849	2,034
Rescues	22,267	22,709	23,164	23,568	23,978	24,385	26,823
Hazardous Conditions	1,488	1,503	1,518	1,529	1,540	1,551	1,706
Service Calls	908	949	992	1,034	1,078	1,124	1,237
Good Intent Calls	3,055	3,144	3,237	3,323	3,411	3,500	3,850
False Alarms	1,044	1,081	1,119	1,156	1,194	1,232	1,355
System Alarms	2,980	3,381	3,837	4,344	4,917	5,563	6,120
Total Calls	**33,515**	**34,558**	**35,677**	**36,776**	**37,955**	**39,204**	**43,125**

The difference between the optimistic and pessimistic forecasts is sizable, over 5,000 incidents in 2005 (9,500 if the extra 10 percent prove correct), which illustrates the difficulty associated with estimating demand in the future, and its sensitivity to assumptions regarding per capita demand. There is also uncertainty in the population estimates; unexpected increases or decreases in population at a given time period may produce variations from this forecast. Because the demand estimates are the product of per capita demand multiplied by population, they cover a variety of scenarios such as larger than expected population growth coupled with lower than expected growth in per capita demand, or vice versa. The main vulnerability in the future estimates is if population explodes more than expected along with much higher demand per capita. (That might happen, for example if there were a surge in low paying entry-level jobs and a huge influx of immigrants.) But that is unlikely and the range in demand should span the actual demand that materializes.

Given the City's experience over the past 10 years and our understanding of the future development patterns, we expect that the actual experience probably will come closer to the pessimistic forecast, particularly over the next few years. The two forecasts are shown graphically in Figure 3.4. The pessimistic forecast calls for continued growth in demand per capita consistent with recent experience, while the optimistic forecast assumes that calls per capita will stabilize.

Figure 3.4: 5-Year Historic and Projected Demand, 1989-2005



2000-2010 Forecasts

The second set of forecasts made was for the long-term projection of demand going out 10 years. The Planning Department's population forecast for the City is that there will be continued population growth throughout the next 10 years and continuing for the foreseeable future. Again, an optimistic and pessimistic forecast was developed for the 10-year period.

Optimistic Forecast – The optimistic forecast again assumes static per capita rates for incidents of all types as done in the short-term forecast. The forecast results are presented only for milestone years of 1999[18], 2000, 2005, and 2010. Table 3.6 presents the optimistic long-range forecast.

[18] Compare projected 1999 to actual for 1999; if possible we should adjust or drop the 1999 column before publishing – it will appear odd to be forecasting 1999 in 2000.

Table 3.6: Incidents by Type, Optimistic 10-Year Forecast

	2000	2005	2010
Estimated Pop.	343.30	357.96	364.50
Fires	1,773	1,849	1,883
Rescues	21,835	22,768	23,183
Hazardous Conditions	1,488	1,551	1,580
Service Calls	847	883	900
Good Intent Calls	2,943	3,068	3,124
False Alarms	994	1,037	1,055
System Alarms	2,360	2,461	2,507
Total Calls	**32,241**	**33,617**	**34,232**

The optimistic 10-year forecast results in over 34,000 incidents in 2010, or an increase of some 4,000 incidents or 13 percent from 1998 to 2010. The calls for service would maintain their relative order of magnitude, with EMS/Rescue remaining the most common type of incident, followed by good intent and then system alarms.

Pessimistic Forecast – The pessimistic forecast assumes compounded growth rates until 2010 for all call types except system alarms. The high growth rate for system alarms is not expected to continue beyond 2005. For other types of calls, it was assumed that per capita demand would level off by 2010 and continue at the same per capita rates thereafter.

The steady pattern of development in Wichita and Sedgwick County lends some confidence to the long-term pessimistic forecast. Absent unexpected changes, the growth rates for calls per capita are not expected to change significantly. In addition, small growth rates do not have a major impact on the final forecast if any one type of call changes its per capita demand slightly.

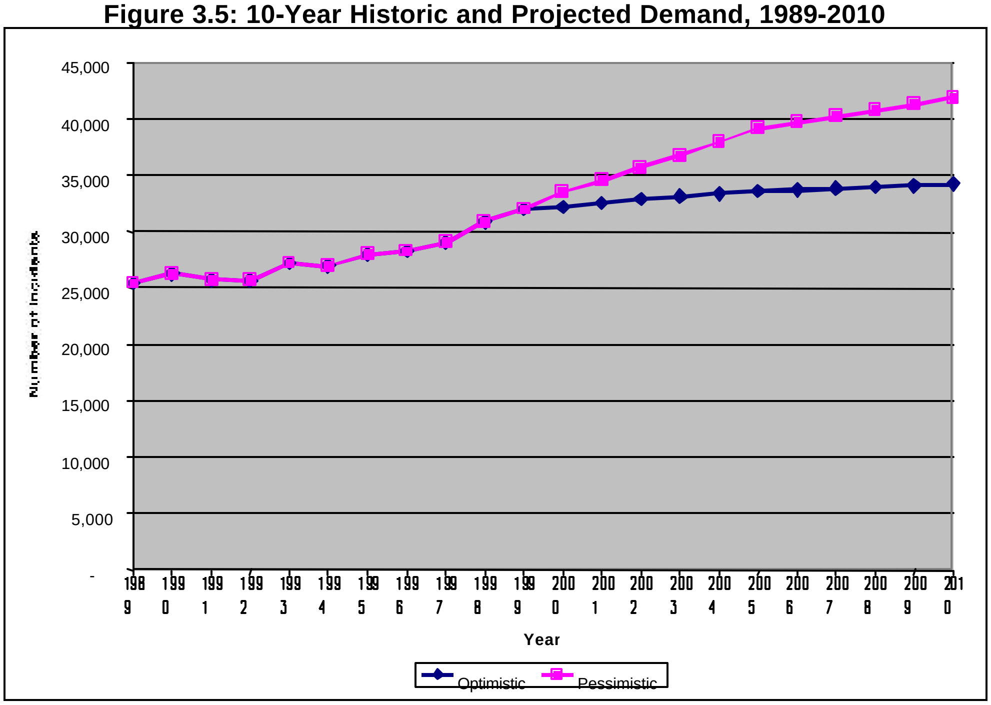
The pessimistic forecast is presented in Table 3.7. This forecast produces an estimated 41,900 incidents in 2010 – a large growth of 38 percent over 12 years based on 1998. The difference between the optimistic and pessimistic forecasts is influenced by the early period of high growth in per capita demand for system alarms from 2000 to 2005. Again, the right-most column shows the result with an extra 10 percent added to the base, as previously discussed; to reflect the potential implication of the jump in the base year 1999 demand; e.g., the effect if per capita demand continues to increase at a compounded rate. Demand might well reach the 46,000 level by 2000. We will examine the implications of these various projections on resources needed, in the next chapter.

Table 3.7: Incidents by Type, Pessimistic 10-Year Forecast

	2000	2005	2010	2010 + 10%
Estimated Pop.	343.30	357.96	364.50	
Fires	1,773	1,849	1,883	2,071
Rescues	22,267	24,385	26,077	28,685
Hazardous Conditions	1,488	1,551	1,580	1,738
Service Calls	908	1,124	1,360	1,496
Good Intent Calls	3,055	3,500	3,916	4,308
False Alarms	1,044	1,232	1,419	1,561
System Alarms	2,980	5,563	5,665	6,232
Total Calls	**33,515**	**39,204**	**41,900**	**46,090**

Figure 3.5 shows the two forecasts on a 10-year basis. The difference between the two forecasts is approximately 7,600 incidents by 2010. We expect that the actual experience of the WFD will fall somewhere between these two extremes, but probably closer to the pessimistic forecast.

Figure 3.5: 10-Year Historic and Projected Demand, 1989-2010



Commentary on Forecasts

These forecasts are estimates of the consequences of future growth in population and area served by the WFD. The steady growth experienced by the City lends a higher than average degree of confidence to this forecast.

System Alarms – At present, the number of system alarms is increasing rapidly, and is the highest growth area in terms of per capita demand for service. As we explained previously, we do not expect the rate of annual growth to continue indefinitely. First, we expect the growth in number of these alarms to begin to decline as large numbers of recently constructed buildings with new systems get beyond their initial stage of higher than "normal" alarms. Additionally, we expect that the WFD's enforcement efforts will be stepped up during the forecast period.[19]

These automatic alarm systems should not be viewed solely as a detriment, because they offer early notification of a fire or smoke condition, and result in an earlier fire service response, resulting in reduced losses. In the case of automatic fire suppression systems, the fire in the vast majority of cases will be controlled or extinguished upon arrival of the fire service. The increased burden placed on responders must be weighed against the need for extended, labor-intensive and dangerous firefighting operations that are averted through reliance on detection and suppression systems. In short, the City should continue to encourage the use of the automatic alarm systems, but provide incentives for building owners to make them more reliable and to maintain them better, such as by using progressive fires.

EMS Demand **–** The predominant demand for service is and will remain Rescue or EMS calls. A key assumption in the long-term forecast was that rates per capita would continue to increase at their present rate throughout the forecast. EMS response in Wichita is delivered jointly by the WFD operating as the first response agency, with Sedgwick County providing transport services. Any change in the relationship between

[19] The City's false alarm ordinance number 41-440 § 1 was first passed in 1991. It has been revised several times since then. Various fines and fees for alarm problems have been added, with the latest to go into effect 1/1/00.

these organizations or policy changes regarding the types of calls that receive a fire department response could have a major impact on rescue demand. These forecasts assume no major changes.

IV. STATION AND UNIT ANALYSIS, 2000-2010

This chapter discusses the implications of planned development and the predicted increase in the number of incidents from 2000 to 2010. The chapter translates the forecast of total incidents into responses by unit, and makes suggestions for additional units and stations.

Unit Demand

In order to determine how well the current system of stations and units could meet the forecast demand, it is necessary to consider demand at the unit level. The number of incidents forecast in Chapter III were translated into the number of unit responses by first determining the past trend in the ratio of responses to incidents. During 1996 to 1998, the WFD made approximately 1.4 responses per incident. This ratio reflects the fact that most incidents are single unit responses. Although fire calls, automobile accidents, and other incidents commonly get a multiple unit response, they are in the minority. Thus, for each forecast period, the number of incidents was multiplied by 1.4 to obtain the number of unit responses.

Once the number of responses was determined, the total percentage of responses made by each unit was examined to see if there were any clear trends of stations increasing their share of citywide responses. Based on three years of data, the changes were minor; Stations 1, 2, and 8 lost the greatest relative share of responses, while Stations 9, 16, and 18 gained the greatest share. The changes were small. Because of the addition of a new station and change in the position of some units over this period, these general trends were used as a guide to allocating responses in the future, rather than by relying on a steady annual change in the percentage of incidents for each year. In other words, we used some judgment based on experience and knowledge about development plans, rather than being totally mechanistic in the computation.

For each forecast year, the number of total responses was estimated. Then these responses were apportioned among the units in service with adjustments made to account for stations with growing demand and for new units that may be added. In the case of new units open for part of a year, their runs were projected on an annual basis and this was used to estimate future responses.

Forecasts 2000-2010: No New Units or Stations – Table 4.1 presents the number of responses in 1996 to 1998 by station. The number of responses indicates where the "busiest" stations are as well as their relative share of all responses in the City. We expect that newly developing areas and new stations will experience a growing share of total responses at the expense of areas that are built-out and may be stable in their number of responses.[20]

Preliminary data for 1999 (not given here) showed the same two stations (Stations 1 and 2) with over 4,000 calls and the same two (Stations 10 and 11) over 3,000 as in 1998. The most significant shifts in responses were a slight drop in calls for Station 14 (the only station to decrease its responses in 1999); an increase in calls for new Station 18 in the northeast, for which 1999 was its first full year of operation; and Station 19, which became the third station to pass 3,000 responses.[21]

Table 4.1: Responses by Station and Percentage of Total Responses

Station	1996 Responses	1997 Responses	1998 Responses	1996 Percentage	1997 Percentage	1998 Percentage
1	4,580	4,217	4,609	0.113	0.107	0.106
2	4,252	3,925	4,169	0.105	0.098	0.097
3	1,530	1,752	1,740	0.038	0.044	0.040
4	2,552	2,510	2,613	0.063	0.063	0.060
5	2,445	2,353	2,463	0.060	0.059	0.057
7	2,100	1,890	2,240	0.052	0.048	0.052
8	1,939	1,638	1,902	0.048	0.041	0.044
9	2,774	2,783	2,813	0.068	0.070	0.065
10	2,813	2,836	3,179	0.069	0.072	0.073
11	3,280	3,240	3,439	0.081	0.082	0.079
12	2,139	1,976	2,094	0.053	0.050	0.048
13	1,334	1,317	1,480	0.033	0.033	0.034
14	2,174	2,402	2,760	0.054	0.061	0.064
15	2,221	2,289	2,392	0.055	0.058	0.055

[20] It would have been better to have data on the number of calls (vs. responses) by first-due area, but that data was not readily available, and usually isn't in other cities, either.
[21] There were still some anomalies in the 1999 data by station that had not been resolved as this report went to press.

Station	1996 Responses	1997 Responses	1998 Responses	1996 Percentage	1997 Percentage	1998 Percentage
16	1,217	1,292	1,490	0.030	0.033	0.034
17	1,131	1,120	1,374	0.028	0.028	0.032
18	0	0	192	0.000	0.000	0.004
19	2,055	2,052	2,389	0.051	0.052	0.055

The first part of assessing station and unit needs in the future is to see what would happen if no changes are made in resource deployment, that is, if no new units or stations are added through 2010. This is useful as a test of the "worst case" scenario in terms of no additions to the fire department to keep up with growth. This section of this chapter deals only with unit activity levels. Response times are discussed later in the chapter.

Optimistic Forecast – Table 4.2 presents the estimated demand for service by unit, based on the optimistic forecast. Estimates are given for the milestone years 2000, 2005, and 2010. The emphasis here should be on the relative level of activity rather than using the data for a "prediction" of actual unit demand in the future.

Table 4.2: Optimistic Forecast, Unit Demand, 2000-2010

Station	Unit	2000	2005	2010
Station 1	AP1	380	402	421
	BAT1	672	733	812
	E1	1,356	1,436	1,505
	E21	694	722	773
	MA1*	329	370	431
	R1	1,719	1,853	2,009
	Subtotal:	*5,150*	*5,516*	*5,951*
Station 2	A2	206	240	298
	BAT2	584	676	825
	E2	1,243	1,289	1,299
	E22	534	553	554
	R2	1,645	1,731	1,796
	Subtotal:	*4,212*	*4,489*	*4,772*
Station 3	E3	574	596	599
	HZM3	98	97	100
	SQ3	1,175	1,196	1,200
	Subtotal:	*1,847*	*1,889*	*1,899*

Station	Unit	2000	2005	2010
Station 4	BOAT4	32	34	37
	E4	1,002	1,080	1,171
	HR4	514	514	545
	SQ4	1,225	1,307	1,390
	Subtotal:	*2,773*	*2,935*	*3,143*
Station 5	E5	935	1,015	1,115
	SQ5	1,641	1,705	1,723
	Subtotal:	*2,576*	*2,720*	*2,838*
Station 7	E7	721	764	803
	SQ7	1,656	1,718	1,729
	Subtotal:	*2,377*	*2,482*	*2,532*
Station 8	Q8**	663	827	837
	SQ8	1,356	1,413	1,436
	Subtotal:	*2,019*	*2,230*	*2,273*
Station 9	AP9	220	248	291
	BAT9	590	669	790
	E9	1,000	1,037	1,042
	R9	1,174	1,216	1,231
	Subtotal:	*2,984*	*3,160*	*3,354*
Station 10	E10	1,040	1,091	1,126
	SQ10	2,333	2,364	2,400
	Subtotal:	*3,373*	*3,455*	*3,526*
Station 11	E11	1,100	1,173	1,245
	SQ11	2,549	2,659	2,711
	Subtotal:	*3,649*	*3,832*	*3,956*
Station 12	Q12	672	721	777
	SQ12	1,550	1,639	1,712
	Subtotal:	*2,222*	*2,360*	*2,489*
Station 13	E13	588	618	642
	SQ13	983	1,000	1,025
	Subtotal:	*1,571*	*1,618*	*1,667*
Station 14	Q14	866	871	822
	SQ14	2,063	2,100	2,150
	Subtotal:	*2,929*	*2,971*	*2,972*
Station 15	Q15	804	843	868
	SQ15	1,736	1,798	1,810
	Subtotal:	*2,540*	*2,641*	*2,678*

Station	Unit	2000	2005	2010
Station 16	A16	22	29	40
	E16	456	464	470
	SQ16	1,102	1,150	1,200
	Subtotal:	*1,580*	*1,643*	*1,710*
Station 17	Q17	434	439	450
	SQ17	998	997	1,014
	TNK17	25	25	21
	Subtotal:	*1,457*	*1,461*	*1,485*
Station 18	A18***	63	90	137
	E18	357	372	379
	SQ18	596	621	633
	Subtotal:	*1,016*	*1,083*	*1,149*
Station 19	Q19	736	763	766
	SQ19	1,799	1,811	1,812
	Subtotal:	*2,535*	*2,574*	*2,578*
Grand Total		**46,810**	**49,059**	**50,972**

E = Engine, Q = Quint, SQ = Squad (Rescue), R = Rescue, AP = Aerial Platform, MA = Mobile Air, Boat = Fireboat, BAT = Battalion Chief, TNK = Tanker, A = Aerial, HR = Heavy Rescue, HZM = HazMat.

* MA1 combines data from MA2 and MA1, based on reviewer's comments. Data was shown separately for these units in the demand data we were originally provided.

** Includes projections of demand based on data reported in 1998 as E8.

*** Includes projected demand from old A5 that was moved to Station 18.

If we use a widely accepted threshold of 3,000 responses to indicate when a unit is effectively overloaded, meaning that it will be unavailable a sufficient amount of time so that response times in its area will degrade, and/or fatigue becomes a factor in the quality of response and firefighter safety, we can see that under the optimistic forecast, no units will exceed this level by 2010. Several units that will have moderately high workloads – Squads 10 and 11, and Rescue 1 will exceed 2,000 responses during the forecast period. The rest of the units will have fewer responses.[22]

The use of squads – two-person quick response units equipped with a small capacity pump and tank – to handle many medical responses and small fires effectively reduces

[22] The figure of 3,000 responses is a guideline that when applied to most departments begins to mark a decrease in unit availability that affects response times. It is not an absolute standard. The figure of 3,000 responses assumes some unit unavailability for training and administrative duties. While fatigue on personnel is a consideration, scheduling is usually not the driving concern in this analysis. The Colorado Springs Fire Department developed a more detailed model of estimating the total work done by a company to determine its true workload – worth asking them about.

the responses for engine companies. Without the squad units, the situation would be very different. They have been an excellent concept introduced by the Department to balance workloads and get good response times.

Pessimistic Forecast – Table 4.3 presents the unit demand projections through 2010 for the pessimistic forecast. This analysis assumes that no changes are made in deployment of existing resources. Later in this chapter, citywide changes in deployment are examined, along with a further analysis of the consequences of these proposed deployment changes on unit workloads.

Table 4.3: Pessimistic Forecast, Unit Demand, 2000-2010

Station	Unit	2000	2005	2010	2010 + 10%
Station 1	AP1	395	469	515	567
	BAT1	699	854	993	1,092
	E1	1,410	1,673	1,842	2,026
	E21	722	843	897	987
	MA1	342	431	528	653
	R1	1,788	2,159	2,459	2,705
	Subtotal:	*5,356*	*6,429*	*7,234*	*8,030*
Station 2	A2	214	280	365	402
	BAT2	608	788	1,010	1,111
	E2	1,292	1,503	1,590	1,749
	E22	556	645	677	745
	R2	1,710	2,018	2,198	2,418
	Subtotal:	*4,380*	*5,234*	*5,840*	*6,425*
Station 3	E3	597	694	734	807
	HZM3	102	112	108	119
	SQ3	1,221	1,394	1,417	1,559
	Subtotal:	*1,920*	*2,200*	*2,259*	*2,485*
Station 4	BOAT4	33	40	46	51
	E4	1,043	1,260	1,433	1,576
	HR4	535	598	668	735
	SQ4	1,273	1,522	1,702	1,872
	Subtotal:	*2,884*	*3,420*	*3,849*	*4,234*
Station 5	E5	972	1,183	1,365	1,502
	SQ5	1,706	1,987	2,109	2,320
	Subtotal:	*2,678*	*3,170*	*3,474*	*3,822*

Station	Unit	2000	2005	2010	2010 + 10%
Station 7	E7	749	890	983	1,081
	SQ7	1,722	2,002	2,117	2,329
	Subtotal:	*2,471*	*2,892*	*3,100*	*3,410*
Station 8	Q8	689	949	1,113	1,246
	SQ8	1,410	1,647	1,758	1,934
	Subtotal:	*2,099*	*2,596*	*2,871*	*3,180*
Station 9	AP9	230	289	356	392
	BAT9	614	780	967	1,064
	E9	1,040	1,208	1,275	1,403
	R9	1,220	1,417	1,506	1,657
	Subtotal:	*3,104*	*3,694*	*4,104*	*4,516*
Station 10	E10	1,082	1,272	1,379	1,517
	SQ10	2,426	2,755	2,773	3,050
	Subtotal:	*3,508*	*4,027*	*4,152*	*4,567*
Station 11	E11	1,144	1,367	1,523	1,675
	SQ11	2,650	3,099	3,318	3,650
	Subtotal:	*3,794*	*4,466*	*4,841*	*5,325*
Station 12	Q12	699	840	951	1,046
	SQ12	1,612	1,910	2,096	2,306
	Subtotal:	*2,311*	*2,750*	*3,047*	*3,352*
Station 13	E13	612	721	785	864
	SQ13	1,021	1,165	1,184	1,302
	Subtotal:	*1,633*	*1,886*	*1,969*	*2,166*
Station 14	Q14	901	1,016	1,007	1,108
	SQ14	2,144	2,358	2,202	2,422
	Subtotal:	*3,045*	*3,374*	*3,209*	*3,530*
Station 15	Q15	835	983	1,063	1,169
	SQ15	1,804	2,096	2,215	2,437
	Subtotal:	*2,639*	*3,079*	*3,278*	*3,606*
Station 16	A16	23	33	49	54
	E16	474	540	546	601
	SQ16	1,146	1,268	1,201	1,321
	Subtotal:	*1,643*	*1,841*	*1,796*	*1,976*
Station 17	Q17	451	512	515	567
	SQ17	1,038	1,161	1,129	1,242
	TNK17	26	29	25	28
	Subtotal:	*1,515*	*1,702*	*1,669*	*1,837*

Station	Unit	2000	2005	2010	2010 + 10%
Station 18	A18	66	104	167	183
	E18	370	434	463	509
	SQ18	620	724	775	853
	Subtotal:	*1,056*	*1,262*	*1,405*	*1,545*
Station 19	Q19	765	889	937	1,031
	SQ19	1,870	2,110	2,096	2,306
	Subtotal:	*2,635*	*2,999*	*3,033*	*3,337*
Grand Total		**48,671**	**57,021**	**61,130**	**67,343**

E = Engine, Q = Quint, SQ = Squad (Rescue), R = Rescue, AP = Aerial Platform, MA = Mobile Air, Boat = Fireboat, BAT = Battalion Chief, TNK = Tanker, A = Aerial, HR = Heavy Rescue, HZM = HazMat.

Under the pessimistic forecast, there would be higher unit response levels as a consequence of the greater number of incidents. Again, looking at the threshold of 3,000 responses, Squad 11 would exceed this level by 2005 and Squad 10 is close behind. Under the current system of cross-staffing several special service apparatus with squads or rescues, one must take into account the combined number of responses by these cross-staffing personnel. With that in mind, Rescue 1 and Aerial Platform 1 will be just shy of the 3,000 response threshold in 2010 (2,974). If demand is 10 percent higher than estimated for 2010 (the right-most column in Table 4.3), the personnel assigned to Rescue 1 and Aerial Platform 1, Squad 10, and Squad 11 would exceed 3,000 runs with 3,272, 3,050, and 3,650, respectively. (Cross-staffed apparatus at Station 2 and Station 4 would near the 3,000 threshold but not exceed it even under the 10 percent extra demand growth.)

Thus, even under the pessimistic scenario, which assumes steadily growing per capita utilization of fire and rescue services, only a few units approach overload by 2010. In turn, this indicates that, in general, *the current system is likely to be adequate to handle the workload for the next decade*. However, handling the workload is not the same as having adequate response times, which is a spatial as well as a temporal problem. Response times must be considered to get a complete picture of the Department’s ability to provide service as the City continues to grow both in area and population. These issues, workload and response time combined, will be discussed under new station and unit recommendations later in this chapter

Based on the foregoing discussion, a few additional units will be needed to handle workload in the 2005 to 2010 period; the need for other units will be based primarily on the desire to maintain adequate response times in already built-up areas and to provide a comparable level of response to newly-developing areas in the future.

Development Patterns, 1997-2010

The next area that must be considered to determine station and unit needs is the likely pattern of development in the City. The City of Wichita is undergoing growth both in terms of population and area protected. The City has a long history of annexations, and they are expected to continue into the future. Since 1980, the City has grown by over 30 square miles. Several annexations are anticipated in the next year.

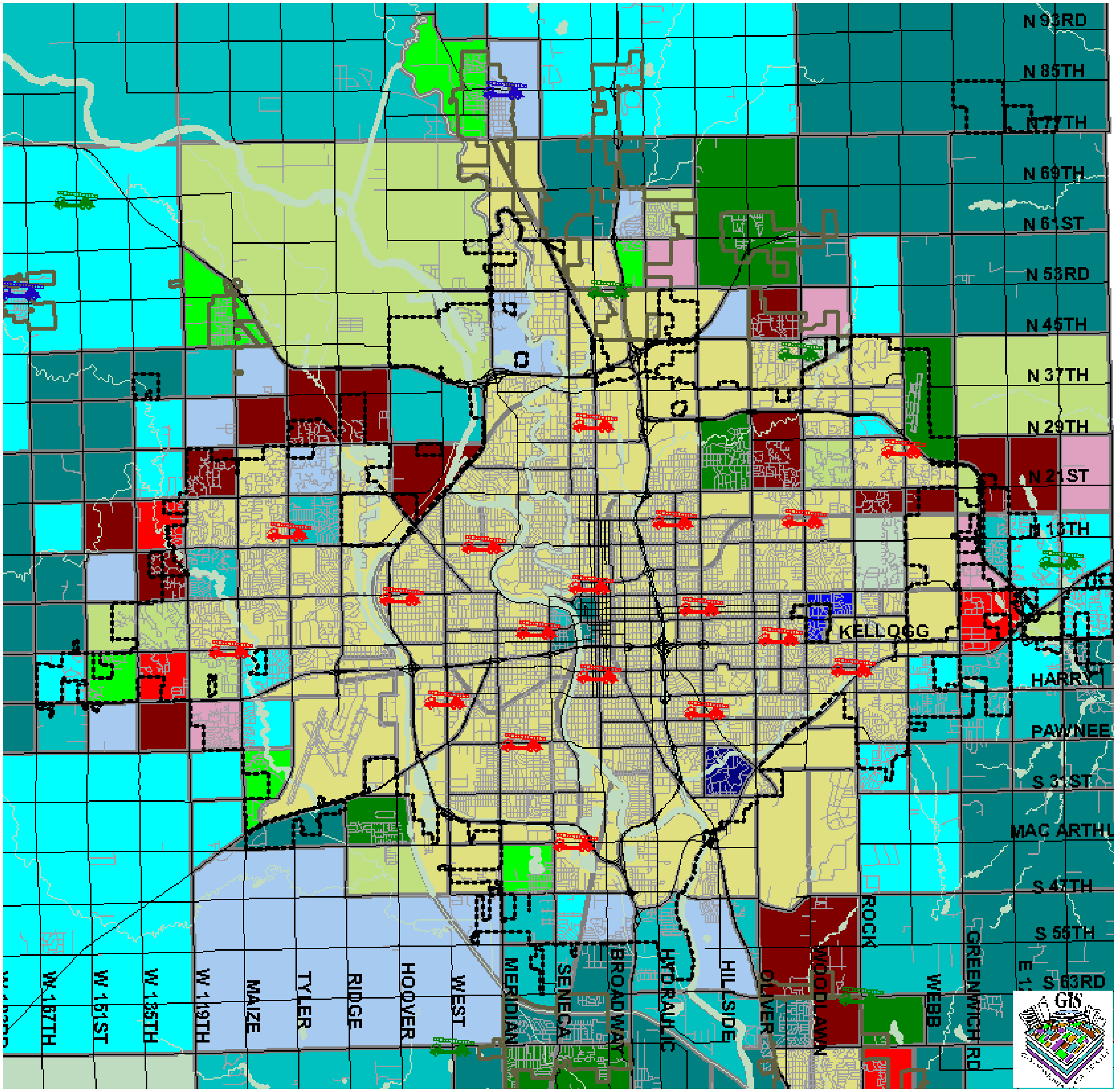
The population growth expected in the City is illustrated in Figure 4.1. The expected population change from 1997 to 2010 is shown for each traffic analysis zone (TAZ) in the County. The areas in dark red (maroon) are expected to experience growth of more than 1,000 people. These areas of highest growth are in the northeast and northwestern corners of the City, along the entire western border of the City, and in the southeast. These maps do not show total population, just the expected growth in population. The area's population will remain concentrated in the older parts of the City, even with the new growth.

The City's longer term development is defined by "New Growth" areas. These are largely located along the City's fringe and are either recently developed or adjacent to developed land. New Growth areas are considered long-term candidates for extension of urban-quality infrastructure and services.

Figure 4.2 shows the planned extent of development by 2030. This map indicated the directions of urban growth. The gold (orange) and yellow areas adjacent to the City limits can be assumed to be part of the City for purposes of long-term analysis.

The City is in the process of executing several annexations in the coming year. These annexations, which tend to occur in conjunction with development of the land at a certain level of intensity, will occur in the following places: first, at the City's eastern border, with plans ultimately calling for the City limits to reach the Butler County line. (This is to the east and south of the area served by Station 18, which opened in 1998); second, in the City's northwest, where significant residential development is taking place; and third, more limited growth and annexation along the City's southern border, in the vicinity of I-235.

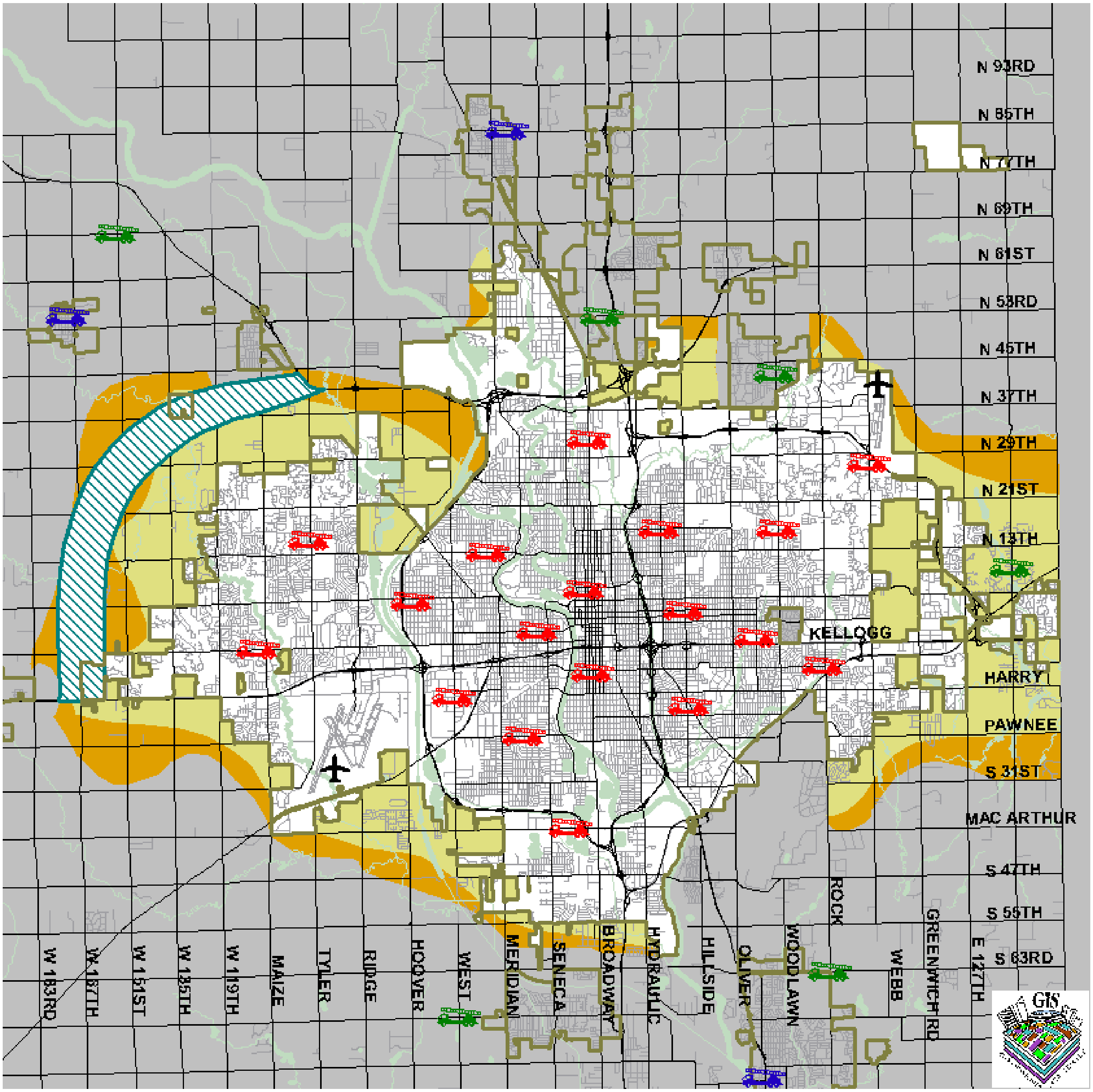
Figure 4.1



Projected Population Change by TAZ 1997-2010

Red = Over 900
Yellow = No Change

Figure 4.2



Proposed Urban Service Areas 2010 - 2030

Yellow = Proposed Urban Service Area 2010
Orange = Proposed Urban Service Area 2030
Hatched = Proposed Northwest Bypass

To summarize, the City of Wichita is expected to continue to grow, both directly and through annexation. The primary directions of growth are to the east and west. Development to the north and south is more limited. The City is expected to retain a majority of the new residents and development in the County for the foreseeable future. The City's population is expected to increase from its current estimated level of 337,000 to over 364,000 by 2010.

The geographic, political and social environment, and the steady and restrained pace of growth, has permitted an orderly approach to future development. On a regional basis, the growth can be accommodated without major disruption to the fire service infrastructure already in place. The City's officials, its planners, and the public deserve credit for managing growth in a way that doesn't place excessive demand on the public sector.

Given these predictions, *the changes necessary to provide service are relatively modest in terms of the new investment needed*.

The next section of this report will discuss options both for providing service to the areas of new development and annexation, and for improving efficiency or effectiveness of the overall system.

Station Needs

The needs for new or alternative station locations were considered in two phases: first, the minimum changes necessary to serve the areas of annexation, and then changes to improve response times or efficiency elsewhere.

The changes recommended are primarily to meet the needs for maintaining response times as the City's area expands with annexation and development at its periphery. The package of changes recommended here represents the culmination of several iterations of prospective changes that were evaluated by TriData and City analysts. They are based on information provided by the Wichita Fire Department and modeled by the City's GIS unit of the Data Center. The proposed set of changes appeared to be the most cost-effective package among the options considered.

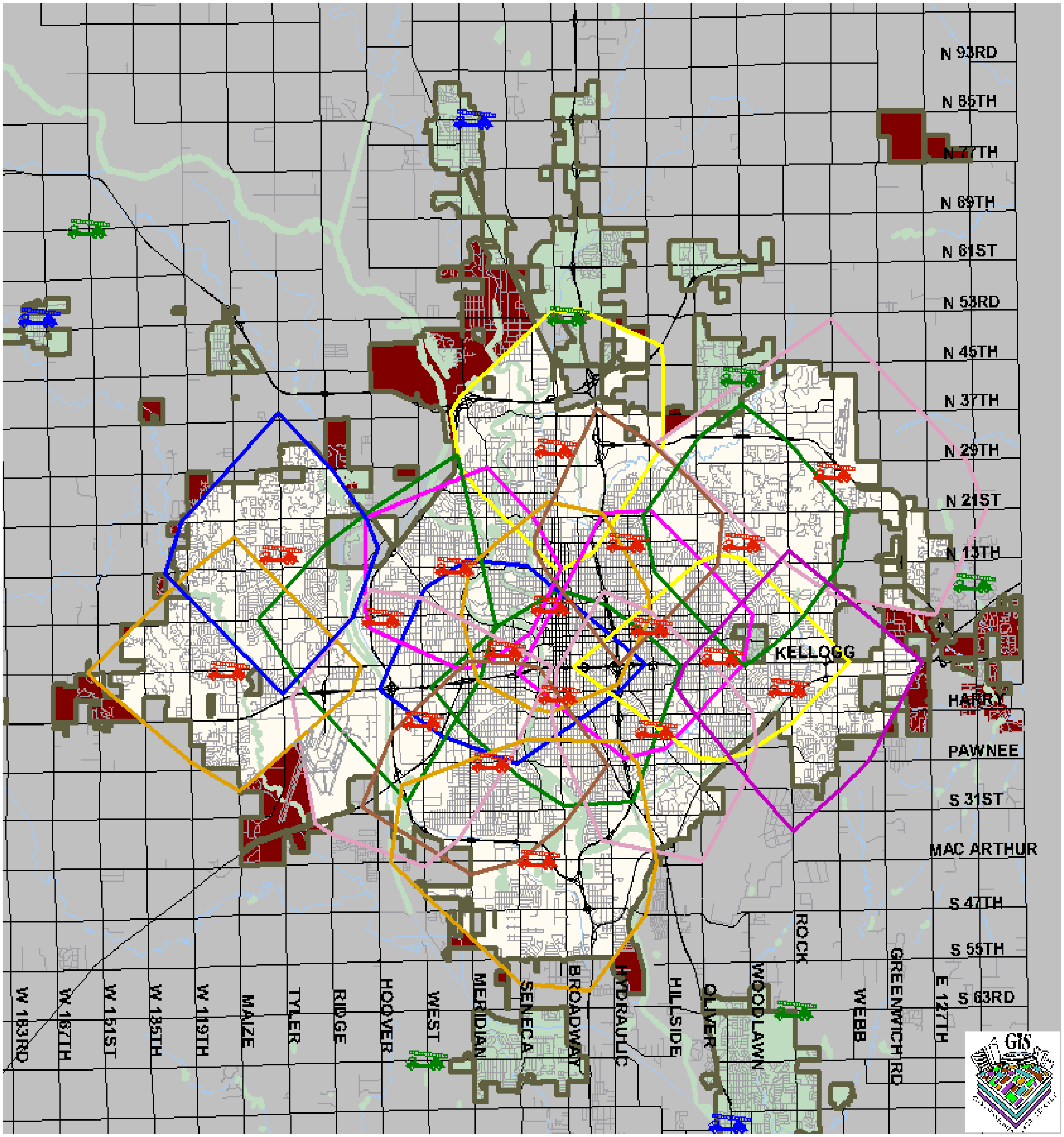
As the City has grown, development patterns have not always coincided with the location of existing facilities. Also, older facilities may be limited in terms of their size and ability to house modern fire apparatus, which has grown larger over the years. As a result of these and other circumstances, adjustment of the location of existing resources can result in improved service.

To develop these recommendations, future population and development patterns and existing calls for service were used to identify potential areas where existing stations could be moved to achieve better coverage, especially first-due response times. After these moves are made, the balance of needs must be satisfied by construction of new facilities. Staffing redeployment was then considered based on the configuration of these station locations.

As a baseline, see Figure 4.3, which shows the nominal 6-minute response time coverage from the existing stations. Note the many areas of considerable overlap in first-due coverage, the spaces between the "rings" of coverage in some areas, and the lack of adequate coverage in some fringe areas. This map is similar to Figure 2.4, but rather than showing 8 stations nearest to each point on the map, it shows the entire area reachable within 6 minutes from each station. Some overlap in station coverage is useful when companies are busy. Neighboring companies can cover the company out on a call and still have reasonable response times. The overlap also means that second-in response times will be better than in areas with little overlap. But when many stations overlap in an area, one must ask whether one or more could be better used elsewhere.

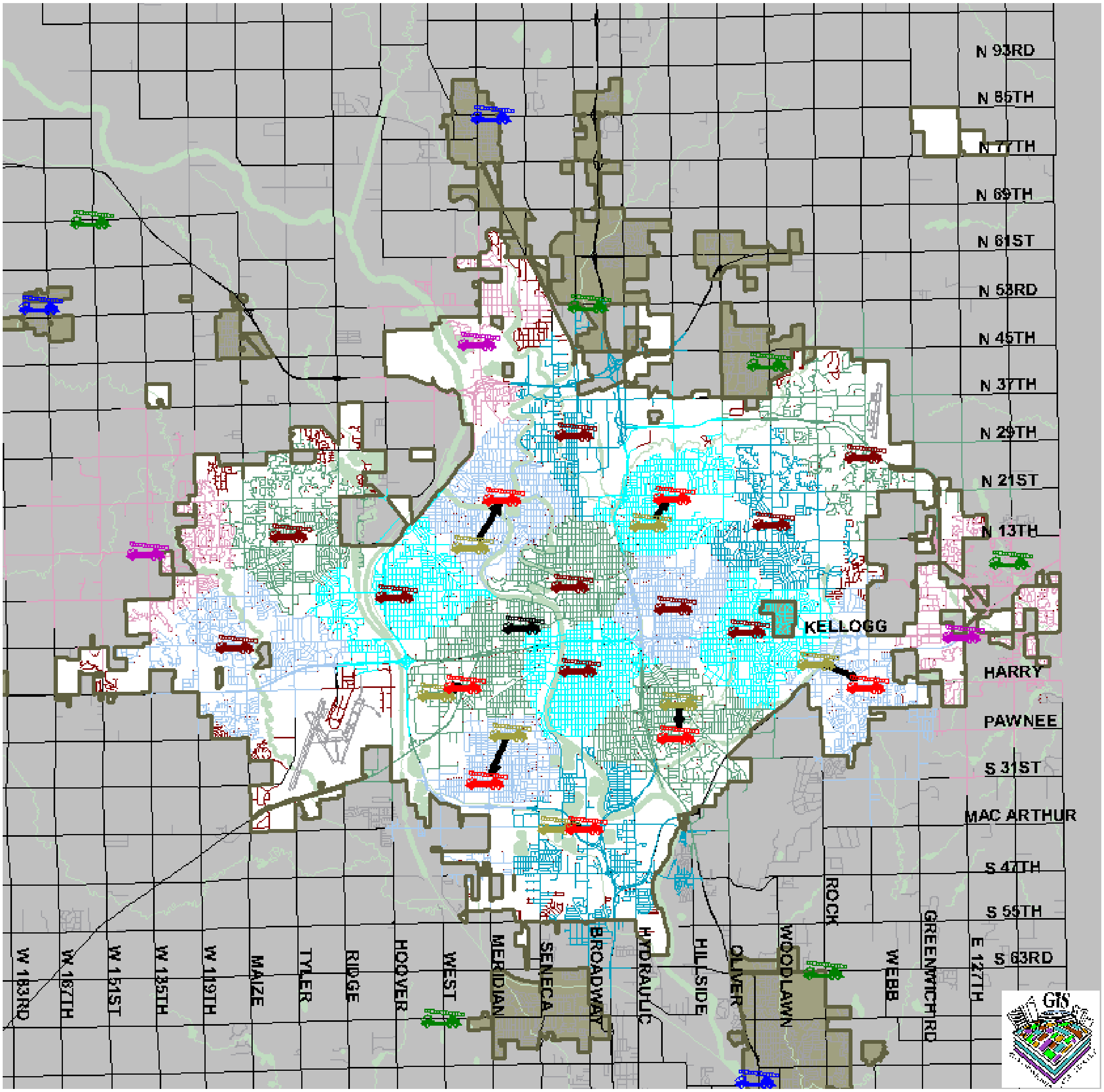
The station location changes will be considered in the approximate chronological order of their recommended construction dates. The exact order should depend on the pace of development and the ensuing demand profile. As the proposed construction schedule goes further into the future, the timing and location of stations becomes less certain, owing to uncertainty in the pace and precise locale of development. In considering station moves, special attention was given to stations that were going to have to be rebuilt or given major renovation anyway because of their poor current condition. The logic was that if they were to be rebuilt, why not do so in a more favorable location? Figure 4.4 shows the proposed station moves and new stations. Table 4.4 summarizes the moves. Each moved or new station is discussed below:

Figure 4.3



Fire Response: Six Minute Generalized Coverage Area

Figure 4.4



Fire Response: Six Minute Proposed Coverage Area

Blue/Green = Good
Brown = Over 6 Minutes response

Station 13 – Relocate approximately one-half-mile east and north along Harry Road to the intersection of Kansas Route 42. This change will allow this station to gain quicker access to Route 42, allowing faster travel to the north and south. It also will provide coverage for some of the area currently served by Station 4 (which we recommend moving, below). The move will have negligible negative impact on response times in its current service area.

Station 12 – Relocate to 31st Street South and Meridian. Station 12 would be moved to the south and west. This move, taken in conjunction with the movement of Station 13, results in better coverage for this area in southeast central Wichita, and reduces some of the overlap evident in Figure 4.3.

Station 19 – Relocate to the east in the area of Broadway and MacArthur, with the primary benefit of improving the ability to cover southern Wichita down to the City limits.

Station 7 – This station is currently in poor condition and is too small for newer apparatus. Additionally, its location is poor relative to the coverage needs in northwestern central Wichita. This station is recommended to be moved to 21st Street North and Amidon. This new position allows correction of existing response deficiencies and provides better support for second-due responses to northern Wichita.

Station 6 – A new station is proposed for northern Wichita, to be located on Meridian between 43rd Street and 46th Street North. This station would provide service to extreme northern Wichita, an area that currently is not served within response guidelines. This station would also provide service to new developments in northwest Wichita, in the vicinity of 37th Street North and Hoover, which are expected to add over 2,000 residents by 2005 and 8,000 by 2010. Station 16 has been providing service to this area, but over 60 percent of the responses exceed the 5-minute response time goal.

The station is numbered “6” to fill a gap in the numbering of stations left by closure of old Station 6 years ago.

Station 15 – To reduce overlap with Station 9’s first-due area, and to better serve southeast Wichita, this station would be moved eastward approximately 1.5 miles to

Webb Road and Harry. Much of its current service area (the western half) would be adequately covered by Station 9.

Station 4 – Relocate from downtown to the east side of Wichita. Station 4's area is now located on the western fringe of downtown. This area is a high fire call area but is very well covered within the response time goals by several other stations. The facility is also approaching the end of its useful life span in that it is too small to accommodate newer fire apparatus. This facility would be relocated to eastern Wichita, near the intersection of 127th Street and Kellogg. The station would serve a portion of the City that currently has poor response times, and is undergoing increased development. It would also have good access to highways to provide service in motor vehicle accidents and to make long distance responses or move-ups.

Station 10 – The existing station is in poor condition and is too small for newer apparatus. This facility is proposed to be rebuilt less than a mile to the north and east at 21st Street North and Hillside.

Station 20 – A new Station 20 would be added in western Wichita to serve the new development and areas anticipated to come into the City as a result of annexation. This location would complement Stations 16 and 17, and provide good coverage to the near-term development as well as the potential long-term annexation boundaries.

Station 11 – The final station move planned before 2010 would be to relocate this facility to the south at Pawnee and Hillside. The new location would improve service to southern Wichita and reduce overlap with other stations.

All of these station location changes are shown in Figure 4.4, along with the coverage for first-due units from the new station locations. As the map illustrates, this plan results in much improved coverage with only one station added to the City. The major cost of a fire department is the personnel, not the facilities. It is cost-effective to move stations rather than add stations and new units to fill gaps, whenever possible.

As noted earlier, this proposed set of stations is not the only solution, but would solve most of the current and foreseeable response time problems over the next decade.

Adding stations virtually anywhere improves the robustness of the entire system by improving second- and third-due response times as well as first-due times, and requiring fewer units to be pulled out of their first-due areas to serve others. The new stations will not only improve response times in the newly annexed areas, but add to the capability of the whole fire system. In other words, citizens throughout the City will benefit from the recommended changes, not just those in the first-due areas of the changes.

Toward the end of 1999, while this study was in its final stages, TriData, the City Manager's office, Finance Department, and Fire Department reached a consensus on the set of recommended station location changes described here. This was a significant development, spurred in part by the process of analysis undertaken by the City's staff under guidance from the study team. (The study's most valuable result may have been to act as a catalyst for that meeting of the minds.) The consensus recommendation is summarized in the table below, with a tentative schedule for prioritizing the construction.

Table 4.4: Summary of Recommended Station Location Changes, 2000-2010

Station Change	Project Start	Open Station
Relocate Station 13 to K-42 and Harry	2000	2001
Relocate Station 12 to 31St S. and Meridian	2000	2001
Relocate Station 19 to Broadway and MacArthur	2000	2001
Relocate Station 7 to 21st N and Amidon	2001	2002
Add Station 6 at 4300-4600 N. Meridian. Close Station 4 where it now is	2001	2002
Relocate Station 15 to Webb Road and Harry	2002	2003
Relocate Station 4 to 127th E and Kellogg	2002	2003
Relocate Station 10 to 21st N. and Hillside	2003	2004
Add Station 20 at 135th W. and 13th N.	2006	2007
Relocate Station 11 to Hillside and Pawnee	2008	2009
Total:	**10 stations to be built: 8 relocated, 2 new stations added**	

The proposed set of changes may be viewed as a combination of a facility upgrade/replacement program and a station location improvement project. We believe that the recommended changes satisfy the general objectives for the long-range master plan and deserves support.

Staffing and Unit Deployment Changes

In the preceding section we focused on station locations. The next aspect of dealing with Wichita's fire protection system is the deployment of units throughout the system and their staffing for the recommended set of station changes.

In a system as large and complex as the WFD, to identify one set of alternatives for deployment of units as *the* best is presumptuous and not supportable with currently available analytical tools for fire department master planning. The existing system of operations has developed over many years, and there are numerous subtleties in unit locations that may not be apparent, even after considerable thought, to an outsider. In some cases, idiosyncrasies in unit deployment resulted from the desire to serve some local area need. In other cases, they may be artifacts of the "way we've always done it" and can be changed. In yet others, they may be important to the fire department's effectiveness and should be left unchanged.

The study team was given two constraints in preparing a master plan – that current safety practices must be maintained and that staffing must not be reduced from its current level. Neither limited the analysis. The main goal was to improve the cost-effectiveness of the system – maintain the level of service as the City grows with efficient deployment of units, as will be discussed next.

Although we present many specific recommendations for station and unit changes, the "big picture" should be viewed in terms of the guidelines for this study. There may be objections raised to various details; in most cases these can be accommodated without undermining the intended effect of the recommended changes. Fine tuning by the collective wisdom of City officials and the fire department would be desirable.

Unit Deployment Principles – At present, the WFD operates with a unique system that relies heavily on cross-staffed units and quints, as was described in Chapter II. This system creates a situation in which both the function of the units and the actual units sent to a given call may vary depending on a number of circumstances.

A key aspect of the present system is the reliance upon quints and cross-staffed aerial ladder companies to provide truck company services on the fireground. Going hand-in-hand with this is the use of some two-person quick attack units (Squads) of which eight are cross-staffed ladder companies or other special service apparatus. The squad trucks are small vehicles with equipment for a medical response or a light fire attack with a single hoseline. However, truck companies often are out of service because their cross-staffed 2-person unit is not available. Also, the ladders run with 2-person staffing, too few to operate as an effective truck company.

The squads are useful in that they provide for a five-person initial attack when both the two-person squad and its associated three-person firefighting company are in quarters and respond together. Additionally, squad companies respond to medical assistance calls and small fire incidents (such as outside rubbish fires), allowing their associated engine to stay in service. This system has allowed the WFD to maintain service levels despite having some relatively high activity levels in some parts of the City.

Given the City's geographic growth, and the increased area that must be serviced, and the increased portion of the workload that is EMS calls and small fires or other services, we believe that it is time that the Fire Department begin to revise its historic emphasis on concentration of resources in the center of the City and at larger fire stations with a philosophy that calls for resources to be more evenly spread throughout the service area to maintain response times both at the first- and second-due levels.

Some additional unit resources are warranted and some reallocation of existing units would be desirable. We based the unit redeployment recommendations on the following principles:

- Greater reliance on dedicated staffing for ladder companies to provide adequate staffing with higher reliability and predictability (at present they may be staffed with as few as two people when their co-located unit(s) are out on other calls). This would improve operations by speeding rescue, ventilation, and other tasks the ladder companies can perform more efficiently when they have enough personnel to work in pairs. It also improves safety by not overstretching the capability of a two-person unit, which is common in emergencies when there is understaffing. (The firefighter culture promotes a can-do attitude, which is excellent much of the time but can also be dangerous at times.) Higher staffing also reduces strains, and helps crews watch out for one another. An alternative is to require firefighters to wait until adequate forces arrive, which increases their safety but delays firefighting and therefore the safety of the occupants.[23]

- Squads are necessary in areas of high activity, but are not well used in areas of low activity, given the need for resources elsewhere to meet response time deficiencies that exist and are likely to grow.

- In recognition of the current need to get more than one unit to the scene of fire incidents quickly in order to provide adequate staffing to start a fire attack under the new two-in/two-out rule, emphasis should be placed on developing more self-sufficient units that can start safety operations immediately without waiting for a second unit. A four-person crew can send a two-person unit into the fire building, and still have two outside, whereas a two- or three-person crew has to delay operations until the second unit arrives. The larger crew speeds up firefighting and EMS, both of which are time critical; the extra two to three minutes for the next closest unit to arrive may literally be fatal.

- Adding more stations provides a more robust response system and allows for units to be out of service for training and administrative duties without the immediate need to address coverage concerns. They also improve the ability to handle simultaneous calls in an area of the City.

Most of the existing types of apparatus being used in the City are appropriate, given the Department's mission and operating practices, with one exception: rescue company apparatus. These units, which are really medium duty utility vehicles, are located at Stations 1, 2 and 9. We believe that these *functions* are necessary, but the vehicles are not. We recommend that these units be retired and that their equipment be placed on truck companies located further from the City center, to provide better truck company coverage citywide.[24]

The use of dedicated ladder companies could allow for substitution of less expensive engine companies for some quints instead of cross-staffing the ladder companies. (The reduced cost of the engine and its greater maneuverability and somewhat lower maintenance are a marginal but positive benefit.)

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[23] Wildland firefighting has been trying to change the firefighter's culture to allow fires to grow rather than take undue risks when staffing is short, but it goes against the grain of those who choose to be firefighters.

The heavy rescue company should take over the "routine" automobile extrication and other duties in Central Wichita in addition to responding as back-up on large or complex incidents and major rescue incidents, as they do now. The staffing of the heavy rescue company should be increased to four dedicated positions, as opposed to three cross-staffed now.

In light of these principles, we recommend consideration of the following unit deployment changes:

- *Move Heavy Rescue 4 to Station 2.* Retire Engine 22 (the second engine at Station 2) and move its staff plus one person from elsewhere to Station 2.[25] Moving the heavy rescue to a larger quarters will provide a larger pool of personnel for its support functions and back-up, as well as adequate space for training and storage needs for the heavy rescue function. Other personnel at Station 2 could be trained and available to supplement the staffing of the heavy rescue as needed.

- *Take Rescue 2 out of service.* Distribute its equipment to Aerial 18.[26] Locating this unit's equipment on a dedicated company will provide a higher availability and locate the unit to provide better coverage.

- *Take Rescue 1 out of service.* Distribute its equipment to Aerial 16.

- *Relocate a quint company to Station 3* to provide improved ladder coverage to the north. Staff Quint 3 with the current Engine 3 staff (i.e., Engine 3 becomes Quint 3). Currently, Station 3 houses a HazMat team and requires a specialized engine. We believe that achieving coverage for an aerial device is more important than maintaining the HazMat team's location. If necessary, the HazMat team should be moved to another facility, along with the specialized engine. Given the

[24] The essential apparatus should fit on the ladder.
[25] The trained rescue personnel should transfer with the heavy rescue, and other personnel moves used to fill in for them. We are concerned here with the numbers, not the particular individuals. The heavy rescue does not have to be at Station 2; new Station 6 might be another candidate, to facilitate training with the County team. The location should be the Department's decision. Note that the proposed plan calls for the heavy rescue to have fully dedicated staffing, so it does not have to be at a low call volume station. The heavy rescue unit needs time to undertake training in its multiple specialties, and to manage its wide array of specialized equipment.

number of new facilities being constructed and the relative insensitivity of HazMat service to response times, we believe the decision on where to locate the HazMat team is best made by fire department staff.

- *Take Rescue 9 out of service.* Distribute its equipment to Quint 3. This provides better rescue coverage associated with a full-time unit.

- *Take Engine 21 out of service and use its personnel elsewhere.* Double engine houses do not take maximum advantage of the response capability of the resources. The second-in engine company's response times from its current station will be somewhat slower, but the overall system better.

- *Increase staffing for outlying or single company stations to 4 personnel from the current 3.* This allows for an immediate interior fire attack when they arrive first, and increases the number of personnel arriving on the scene of full assignments in the early minutes.[27] While the use of a single unit would increase the number of personnel responding to medical and other responses that may previously have been handled by a two-person squad, in the outlying stations that had a squad, the relatively low activity levels allow for a single, self-sufficient unit to handle these responses with the extra person better utilized elsewhere in the system.

- *Provide dedicated staffing for ladder companies, rather than cross-staffing them.* This will improve response times of ladder units and the time it takes to assemble an effective force for firefighting. These companies still will be available to respond to rescue (EMS) calls, splitting the load with their associated engine companies.

- *Continue using squad companies.* Place them where necessary to prevent an excessive workload on the remaining units, or in areas of marginal response times, where their rapid travel and turnout ability would be helpful, especially for EMS calls (most get preserved under this criterion).

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[26] Most if not all of the equipment on the rescues should fit on the ladder trucks.
[27] Technically, the two outside would not properly constitute a rapid intervention team (RIT) because they have other duties. But in a non-OSHA area, that is still much better than the situation with a three-person crew, and would be legitimized by even OSHA/NFPA standards as soon as the next two or more person unit arrives.

Response Complement for Structure Fires – The new staffing profiles and unit deployment suggested above would result in the addition of at least one person to the fireground over the system for responses to most fire calls. We would suggest that for purposes of structure fire response, the assignments be simplified to engines and ladders, with the understanding that available squad companies whose primary piece was dispatched would also respond. Where there is an engine and squad, there would be 5 personnel responding with the engine (if the squad is available); where there is an engine alone, there would be 4 personnel. In single company areas, the four-person unit staffing would result in more personnel responding on the initial alarm and allow time to go inside if necessary and still meet the safety criteria of having two outside.

Battalion Chiefs – The current distribution of Battalion Chiefs has been concentrated in the center city in the same general area – at Stations 1, 2, and 9. That has the advantage of concentrating them where larger fires are most likely to occur but gives them longer responses to outlying areas. The Fire Department reported that only Stations 1, 2, 9, 11, 12, 16, 17, and 18 can accommodate a Battalion Chief, considering housing, office space, and sleeping quarters. This seriously limits a Western move of Battalion Chiefs and other relocations, but it is still highly desirable to consider a better distribution of Battalion Chiefs. We believe that a better arrangement would be to position Battalion Chiefs at Stations 1, 9, and 17 or 2, 9, and 17. This would provide faster Battalion Chief response times throughout the City. Another alternative would be to move a Battalion Chief to one of the newly constructed west side stations, which would provide better distribution but leave the Battalion Chief closer to the center city.

Summary of Staffing and Unit Recommendations – Table 4.5 summarizes staffing and positioning of units under the suggested reorganization plan and compares the proposed deployment to the current deployment.

Table 4.5: Recommended New Configuration of Station Locations and Units

Station	New Address	Current		New	
		Unit	On-Duty Staffing	Unit	On-Duty Staffing
1	731 N. Main	E1 AP1 MA1 — R1 BAT1 E21	3 X 1 — 2 1 3 *Subtotal: 10*	E1 AP1 MA1 SQ1 — BAT1 —	3 3 2 +1 (mobile air person) 1 — *Subtotal: 10*
2	1240 S. Broadway	E2 A2 R2 BAT2 E22 Boat 2*	3 X 2 1 3 — *Subtotal: 9*	E2 A2 HR2 SQ2 — Boat 2	3 3 4 2 — X *Subtotal: 12*
3	25th Street North and Arkansas Street	E3 HZM3 SQ3	3 X 2 *Subtotal: 5*	Q3 HZM3 SQ3	3 X 2 *Subtotal: 5*
4	127th Street East and Kellogg	E4 HR4 SQ4 Boat 4	3 X 2 X *Subtotal: 5*	E4 — SQ4 —	3 — 2 — *Subtotal: 5*
5	257 N. Hillside	E5 SQ5	3 2 *Subtotal: 5*	E5 —	4 — *Subtotal: 4*
7	Amidon and 21st Streets North	E7 SQ7	3 2 *Subtotal: 5*	E7 SQ7	3 2 *Subtotal: 5*
8	661 N. Elder	Q8 SQ8	3 2 *Subtotal: 5*	Q8 —	4 — *Subtotal: 4*

Station	New Address	Current		New	
		Unit	On-Duty Staffing	Unit	On-Duty Staffing
9	350 S. Edgemoor	E9 AP9 R9 BAT9	3 X 2 1 *Subtotal: 6*	E9 AP9 — BAT9	3 3 — 1 *Subtotal: 7*
10	21st Street and Hillside	E10 SQ10	3 2 *Subtotal: 5*	E10 SQ10	3 2 *Subtotal: 5*
11	Hillside and Pawnee	E11 SQ11	3 2 *Subtotal: 5*	E11 SQ11	3 2 *Subtotal: 5*
12	31st Street and Meridian	Q12 SQ12	3 2 *Subtotal: 5*	Q12 SQ12	3 2 *Subtotal: 5*
13	K-42 and Harry	E13 SQ13	3 2 *Subtotal: 5*	E13 —	4 — *Subtotal: 4*
14	6408 Farmview	Q14 SQ14	3 2 *Subtotal: 5*	E14 SQ14	3 2 *Subtotal: 5*
15	Webb and Harry	Q15 SQ15	3 2 *Subtotal: 5*	Q15 SQ15	3 2 *Subtotal: 5*
16	1632 N. Tyler	E16 A16 SQ16	3 X 2 *Subtotal: 5*	E16 A16 —	3 3 — *Subtotal: 6*
17	W. 119th Street and Route 54	Q17 TNK17 SQ17 —	3 X 2 — *Subtotal: 5*	E17 TNK17 SQ17 BAT17	3 X 2 1 *Subtotal: 6*
18	2808 N. Webb Road	E18 A18 SQ18	3 X 2 *Subtotal: 5*	E18 A18 —	3 3 — *Subtotal: 6*

Station	New Address	Current		New	
		Unit	On-Duty Staffing	Unit	On-Duty Staffing
19	MacArthur and Broadway	Q19 SQ19	3 2 *Subtotal: 5*	Q19 SQ19	3 2 *Subtotal: 5*
20** (New)	134th Street West and 13th Street North			Engine Squad	3 2 *Subtotal: 5*
6 (New)	43rd Street North and Meridian			Quint	4 *Subtotal: 4*
Total:		**14 E** **6 Q** **5 A** **14 SQ** **3 R** **<u>Other</u>** **1 TNK** **1 HR** **1 MA** **1 HZM**	**100 (+ 1 Roving Captain)**	**14 E** **6 Q** **5 A** **13 SQ** **0 R** **<u>Other</u>** **1 TNK** **1 HR** **1 MA** **1 HZM**	**113 (+13 over current on-duty staffing, plus the 1 Roving Captain)**

X = Cross-staffed
* Cross-staffed with the heavy rescue.
** Not sure how it would be numbered.

2000-2005 **–** This revised staffing plan would create dedicated staffing for ladder companies, increase staffing on outlying companies, and create dedicated staffing for the heavy rescue squad. It adds three new stations with a net increase in on-duty staffing of 13 positions.[28] The main change is giving up the rescues, which increases the busyness of the engines, but not to excess.

Through selective reallocation of personnel, this plan increases unit staffing and creates a more stable operating environment by placing five ladder companies into full-time service. With more staffed companies, there will be greater flexibility in terms of taking companies out of service for training and administrative activities during the daytime.

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[28] If the roving Captain to cover vacant Captain positions is truly considered a duty position different in kind from the extra firefighters needed on each shift to cover for firefighters, then there is one more on-duty position to be counted. The roving Captain is needed and so are extra firefighters and Lieutenants. We do not think that should be counted as an on-duty position, but that is a local call.

Additionally, cross-staffed companies currently or expected to approach or exceed the 3,000 response threshold level will be alleviated of this burden as two distinct crews will split the number of calls.

Further, we recommend that the heavy rescue continue to be dispatched on all reported working fires as well as for the other specified hazards it already goes to with dedicated staffing. This unit should be more fully utilized as a resource at fires as well as heavy rescue incidents.

2005-2010 – For this period, an additional 2 squads (4 on-duty positions) may be needed to relieve workloads for Quint 8 and Engine 5, as will be discussed in the next section. They might be needed in these locations, elsewhere or not at all, depending on how demand gets distributed in detail.

Summary of Staffing Changes – To give another perspective to understand the recommendation, a summary of the proposed changes to units and staffing is presented in Table 4.6. The proposal calls for the addition of 13 on-duty shift positions in operations over the current 100 on-duty positions. (There are a net 13 more positions on units, not counting the roving Captain.) Personnel previously assigned to apparatus recommended to be placed out of service can fill most of the positions for the proposed new units. Each on-duty position requires 3.4 firefighters to fill it to maintain shift around-the-clock coverage. Thus the 13 new on-duty positions require adding 44 firefighters over a 10-year period. Of the 13 on-duty positions, 8 are due to adding stations to keep up with growth, and 5 to increase staffing of existing units (along with the positions gained by closing rescues and double engine companies).

Table 4.6: Summary of Proposed Staffing Changes

Apparatus Changes	Staffing Change	Net Change
Provide full-time staffing for five aerial apparatus (A2, A16, A18, AP1, AP9)	5 apparatus @ 3 personnel each	+15
Remove two engines from Service (E21, E22). Replace two engines with quints (E3, E14)	- 2 apparatus @ 3 personnel each	-6
Upstaff two engines (E5, E13)	2 apparatus @ 1 personnel each	+2
Place one new engine in service (E20)	1 apparatus @ 3 personnel each	+3
Staff one heavy rescue full-time (HR2)	1 apparatus @ 4 personnel each	+4
Place one new quint in service (Q6).	1 apparatus @ 4 personnel each	+4
Upstaff one quint (Q8)	1 apparatus @ 1 personnel each	+1
Remove three rescues from service (R1, R2, R9)	- 3 apparatus @ 2 personnel each	-6
Remove five squads from service (SQ5, SQ8, SQ13, SQ16, SQ18). Relocate three of these squads to new stations (SQ1, SQ2, SQ20)	- 5 apparatus @ 2 personnel each 3 apparatus @ 2 personnel each	-10 +6
Total		**+ 13 new on-duty positions**

Implications of New Stations and Unit Deployment

To more specifically explore the workload implications of the proposed new station and unit deployment plan, the projected number of responses were allocated among the new units in service. These estimates are less certain than the current deployment scenario presented at the beginning of this chapter because of the variation in the pacing of development and the timing of opening of new stations. Nevertheless, it is still informative to explore some potential scenarios.

For each scenario, we assumed that new stations would be phased in between 2000 and 2007, as proposed in Table 4.4. As a result, new stations appear in the 2005 and 2010 milestone years.

The optimistic forecast shows projected unit workloads for 2000, 2005, and 2010. There is some uncertainty in predicting the workload consequences of all the changes, but we do not anticipate that any units will become overloaded, with the possible exception of Engine 5. If that unit exceeds 3,000 responses, we would recommend that its squad company be restored (sometime between 2005 and 2010 in our pessimistic forecast). Quint 8 and Squad 11 would be busy, close to 3,000 runs per year. (All unit workloads need to be continually monitored, and squads added if they get over 3,000 or if other response problems develop.)

The unit responses under the optimistic forecast are presented in Table 4.7 and for the pessimistic forecast in Table 4.8.

Table 4.7: Optimistic Forecast with Unit Changes and New Stations

Unit	2000	2005	2010
E1	1,357	1,802	1,856
AP1	668	722	733
SQ 1	1,489	2,058	2,225
E2	1,196	1,612	1,650
A2	713	793	851
HR2	1,451	1,564	1,644
SQ2	792	1,256	1,315
Q3	553	752	771
HM3	95	97	88
SQ3	1,131	1,583	1,560
E4 (Old)	965	*	*
SQ4	1,179	*	*
E5	2,515	2,781	2,948
E7	694	565	599
SQ7	1,594	1,186	1,219
Q8	1,942	2,772	2,877
E9	1,246	1,340	1,350
A9	1,060	1,160	1,214
E10	1,001	1,091	1,126
SQ10	2,245	2,363	2,266
E11	1,059	1,172	1,245
SQ11	2,452	2,657	2,711
Q12	647	828	894
SQ12	1,492	1,808	1,893

Unit	2000	2005	2010
E13	1,511	1,894	1,907
Q14/E14	834	870	822
SQ14	1,985	2,022	1,799
Q15	774	758	781
SQ15	1,670	1,618	1,629
E16	1,235	1,407	1,182
A16	288	301	285
E17	418	418	270
TK17	25	25	21
SQ17	961	997	609
E18	917	794	809
T18	792	692	718
E4* (New Eastside)	0	283	289
SQ48 (New)	0	353	361
E20	0	0	176
SQ20	0	0	410
Q6 (Northside)	0	465	462

* After moving Station 4 to the east side. Station 4 is shown in two separate places, first its current location, and then its new location; unlike the other moved stations its demand picture is totally different in its new location. The general method used to reallocate old Station 4's responses to its neighboring stations was to give 30 percent each to Stations 1 and 2 and 10 percent each to Stations 12, 13, 7, and 8 for fire calls. For EMS responses, 30 percent each went to Stations 1 and 2, with roughly 13 percent going to Stations 12, 13, and 7. These are rough approximations.

The projected number of unit responses under the pessimistic forecast are shown in Table 4.8. Three units would be at or over the workload threshold of 3,000 calls per year: E5, Q8, and SQ11. If demand were 10 percent higher than the pessimistic estimate, only these same three units would be over 3,000 responses, but SQ10 would be close to that level, too.

Table 4.8: Pessimistic Forecast with Unit Changes and New Stations

Unit	2000	2005	2010	2010 + 10%
E1	1,368	1,707	1,990	2,189
AP1	700	715	818	900
SQ 1	1,561	1,971	2,330	2,563
E2	1,253	1,589	1,825	2,008
A2	747	763	898	988
HR2 (4)	1,522	1,553	1,770	1,947
SQ2	830	1,225	1,422	1,564
Q3	579	741	851	936
HM3	99	101	109	120
SQ3	1,185	1,589	1,792	1,971
E4	1,012	*	*	*
SQ4	1,236	*	*	*
E5	2,636	2,691	3,148	3,463
E7	727	549	614	675
SQ7	1,671	1,188	1,387	1,526
Q8	2,036	2,798	3,285	3,614
E9	1,305	1,333	1,517	1,669
A9	1,111	1,134	1,313	1,444
E10	1,049	1,071	1,235	1,359
SQ10	2,354	2,403	2,675	2,943
E11	1,110	1,133	1,327	1,460
SQ11	2,571	2,624	3,009	3,310
Q12	678	795	939	1,033
SQ12	1,564	1,849	2149	2,364
E13	1,584	1,846	2101	2,311
Q14/E14	874	892	986	1,085
SQ14	2,081	2,124	2,289	2,518
Q15	810	745	858	944
SQ15	1,750	1,608	1,832	2,015
E16	1,295	**1,616	**1,447	1,592
A16	301	307	340	374
E17	438	386	**298	328
TK17	26	26	28	31
SQ17	1,008	794	**676	744
E18	961	785	899	989
T18	830	678	784	862

Unit	2000	2005	2010	2010 + 10%
E4* (New station)	0	279	320	352
SQ4* (New station)	0	348	399	439
E20	0	0	195	215
SQ20	0	0	455	501
Quint (Northside)	0	464	525	578

* Station 4 is relocated to new eastside station. Treated as a new station after 2005. See footnote on Table 4.7.

** Decrease from adding Station 20.

As overloads occur on individual units, the Department should consider whether there is a way to better share the call-load between units in the same station, rotate crews between the units, or both. For example, Engine 11, with half the projected call level of Squad 11, could handle more EMS calls, or handle all calls other than EMS that Squad 11 might be sent on. For Quint 8 and Engine 5, which are isolated single units, WFD should consider adding a two-person squad when the demand builds up.

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Overall, the current fire deployment system can absorb much of the growth going into the future. Adding two stations and moving eight others will provide efficient coverage through 2010 to both the existing City and the anticipated new annexed areas.